Application of 3DFT CISS Imaging Technique : Demonstrations of Internal Auditory Canals, Salivary Ducts and Lacrimal Ducts.

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Purpose: Fast Imaging with Steady Precession(FISP) and reversed FISP(PSIF) sequence basically depends on the steady state of both longitudinal and transverse magnetization. This steady state free precession pulse sequence shows heavily T2 weighted images, however the flow induced phase shift artifact is a main disadvantage. One of the flow compensated steady state techniques, Constructive Interference in Steady State(CISS) sequence is a newer technique with combination of true FISP and PSIF images using alternating(+/-) and non-alternating(+/+) RF pulse shema. The purpose is to evaluate of CISS sequence as an alternative or additional imaging tool for examining the inner ear, the salivary ducts and the lacrimal drainage systems

Materials and Methods: Inner ears and salivary ducts(SD) of 10 normal subjects and nasolacrimal ducts(NLD) of 5 normal subjects were studied to depict imaging features of the normal anatomy using 3-DFT CISS sequence. Ten patients with ductal calculi and swelling of the salivary glands and 5 patients with epiphora were included in this study. Five patients with salivary pathology underwent conventional x-ray sialography and 3 patients with epiphora underwent digital subtraction dacryocystography(DSDCG). On MR imaging of NLD, instillation of Gd-DTPA in a 1:50 diluted solution with normal saline was given intermittently into each eye during MR study. MR parameters used with CISS sequence were 17 msec/2~8 msec / 50°(TR/TE/FA), matrix of 156 x 256 ~ 224 x 512, nominal thickness 0.5 ~ 0.9 mm, FOV 220 ~ 250 mm and 1 NEX. The total acquisition times were 4 minutes(SD and NLD) and 8 minutes(inner ear). Applying a targeted maximum intensity projection (MIP) on the 3-DFT CISS images made three-dimensional reconstructions.

Results: In the both ears, the very high signal of the intralabyrinth fluid enable one hundred percent(20/20, 10 subjects) of the membranous labyrinth to be seen. In MR imaging of inner ears, there was a lack of contrast between soft tissue and bone including facial nerve canal, vestibular aqueduct and canal of subarcuate artery. The vascular loops of anterior inferior cerebellar artery(16/20) which form near the cisternal portion of the VII and VIII cranial nerves well recognized in all images. MIP reformations showed cochlear and vestibule. MR sialography demonstrated both normal and abnormal parotid and submandibular duct system. In 10 patients, CISS demonstrated sialectasia(5/10), calculi in the submandibular ducts(2/5). One patient showed sialodochoadenitis in parotid gland due to pyogenic infection. Secondary branches of the ducts were not well demonstrated in MIP reformation. One patient who complained swelling and pain in the both submandibular glands showed cervical lymphadenopathy resulting from tuberculosis. MR dacyrocystography showed normal anatomical structures(5/5) and pathology of occlusion(3/5) or stenosis(2/5) of the nasolacrymal ducts. MR images were compatible to the digital subtraction dacryocystography. Superior and inferior canaliculi were not seen in MR DCG.

Conclusions: The CISS sequence shema allows reliable imaging of detailed structures of the inner ears and can successfully demonstrate both normal and abnormal salivary duct and nasolacrimal duct systems, which contain slow flowing fluid. This serves several advantages over the conventional x-ray sialography and dacryocystography in case of hypersensitivity to the contrast media, duct infection and failure of intubation. This special MR technique can be added as a routine protocol in the study of disease of the inner ear, and has the potential to provide important clinical information especially in patients who cannot undergo conventional radiologic studies.

1. Stillman A.E., Remley K, Loes D.J., Hu X., Latchaw R.E. Steady-state free precession imaging of the inner ear. *AJNR* 15:348-350, 1994
2. Casselman J.W., Kruhweide R., Diemling M., Ampe W., Dehanes I., Meeus L. Constructive interference in steady state-3DFT MR imaging of the inner ears and cerebellopontine angle. *AJNR* 14:47-57, 1993
3. Casselman J.W., Kruhweide R., Diemling M., Ampe W., Meeus L. Steyart L. Pathology of the membranous labyrinth: comparison of T1 and T2 weighted and gadolinium-enhanced spin-echo and 3DFT-CISS imaging. *AJNR* 14:59-69, 1993
4. Loma D.J., Carroll N.R., Johnson G., et al. MR sialography : work in progress. *Radiology* 200:129-133, 1996