Evaluation of MR Image Overlay for Spinal Interventions

Motivation

MRI-Guided Spine Interventions

• MR facilitates diagnosis and treatment of degenerative disease of the spine.

• MR guidance is used for a host of spine injections and pain management procedures:
  Discography, periradicular nerve blocks, sympathetic blocks, celiac plexus blocks, sacroiliac joint injections, and facet (zygoapophysial) joint neurotomies

• MR imaging provides exceptional depiction of the vertebral column, intervertebral discs and spinal nerves
**Motivation: Other Applications**

**MR Arthrography**
- Used in assessing ligament and fibrocartilage injuries of joints
- Comparable diagnostic efficacy to joint arthroscopy, less invasive
- Often involves injecting contrast directly into the joint space

**Typical workflow** (Two distinct procedures)
1. Insert needle into joint space under CT or Fluoro & inject Gadolinium contrast
2. Visualize joint under diagnostic MRI

**Solution – Combine Intervention & Imaging**
1. Needle insertion with contrast injection in MR imaging room
2. Real-time imaging not necessary, patient can be translated out for insertion

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**MRI Image Overlay**

**Overlay device in position**
- Frame
- LCD display
- Mirror with overlaid image

**Typical view during needle insertion**
- Planned path overlaid on anatomical images
- Skin fiducial
- Virtual needle guide
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Image Overlay Guidance

**MR Image Overlay System**

**Equivalent CT Overlay System**

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Offline System Evaluation

**Laboratory Validation Testbed Using Electromagnetic Tracking**

- Planning Software
- Tracking & Logging Software
- Image Overlay
- NDI Aurora EM Tracker
- Lumbar Spine Phantom
- Overlaid Image
- Tracked Needle

Results

N=60 Trials With Experienced Radiologist

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Representative Trajectories

Shows variability in insertion technique
Can be used for training and evaluation
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Summary

• Simple image overlay system implemented for use on MR (and CT) scanners

• Allows needle insertions without taking attention away from the interventional site

• Overlay guidance provide for better accuracy with fewer needle insertion attempts

• Training fixture for clinician evaluation

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