Introduction and Overview

“Seeing is Believing”
CLEARPOINT® MRI-Guided Neuro Navigation Platform

Enabling Real-Time MRI Visualization Throughout Neurosurgical Procedures

ClearPoint enables a surgeon to see and select the target location, establish the desired trajectory, and visualize the surgical device via MR images during insertion.

One Platform, Multiple Applications

Real-time Visualization

Immediate Feedback

Confirm Before You Close

Electrodes • Laser Ablation Catheters • Drug Delivery Catheters • Biopsy Needles

Confidence • from Beginning to End with • Real-Time MRI Visualization
Cardiovascular Surgery
Revolutionized by fluoroscopy in the late 1970’s

Today:
1.5 million procedures/yr

Orthopedic Surgery
Revolutionized by arthroscopy in the 1980’s

Today:
1.2 million procedures/yr

Abdominal Surgery
Revolutionized by laparoscopy in the late 1980’s

Today:
4.0 million procedures/yr

Spine Surgery
Revolutionized by endoscopy in the 1980’s

Real-time, Image-Guided Minimally Invasive Procedures...applied across multiple medical specialties
ClearPoint: Real Time Image Guided Minimally Invasive Neurosurgery

Courtesy of Dr. Mark Richardson, UPMC and MRI Interventions
ClearPoint Neuro Navigation Platform

*An integrated system of hardware components, disposable components and intuitive, menu-driven software*

Designed to work within a hospital’s existing diagnostic MRI scanner
ClearPoint Procedure Overview

Target Selection & Entry Planning

ENTRY PLANNING
ClearPoint Procedure Overview

Trajectory Alignment & Device Insertion
The ClearPoint Navigation Platform

*Enabling A Variety of Minimally Invasive Neurosurgical Procedures*

**Laser Ablation Catheters**

**Electrodes**

**Biopsy Needles**

**Drug Delivery Catheters**

*Demonstrated submillimetric accuracy*
Accuracy Matters

The ClearPoint System Delivers Precision

Preclinical Accuracy

Preclinical cadaver experiment: approx. 0.2 mm radial error

Clinical Accuracy

400+ ClearPoint cases
500+ electrodes placed
Approx. 0.68 mm accuracy across all electrode placement procedures*

Brain Shift

Conclusions: Brain shift is continual and unpredictable....

* Data on file at MRI Interventions
ClearPoint Procedures are Performed in Diagnostic MR Scanners

1.5T or 3T MR Scanners, also works in intraop MRI Suites

University of Pittsburgh Medical Center

UCSF Medical Center

Emory University Hospital

Brigham and Women’s Hospital*

*Image courtesy of IMRIS, Inc.

Integrates with All Major Scanner Platforms

SIEMENS  PHILIPS  GE Healthcare  IMRIS  BrainSUITE
### Patient Opportunity for Real-Time, MRI Guided Minimally Invasive Neurosurgery

#### US Patient Populations

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<th>Neuro Disorder</th>
<th>Patient Population</th>
<th>Treatment Resistant Patient Population</th>
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<td>Epilepsy</td>
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<td>Brain Tumor</td>
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<td>Huntington’s</td>
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= Massive unmet patient need

#### Therapeutic Approaches

- Electrode Placement
- Focal Ablation
- Biopsy
- Direct Drug Delivery

ClearPoint Platform Supports All of These Current and Emerging Therapeutic Approaches
ClearPoint Platform Enables New Approaches

... for an Expanding Variety of Neurosurgical Procedures

Placement of Electrodes
Depth electrodes, DBS electrodes...

Placement of Laser Ablation Catheters
For hippocampal ablation, ablation of tumor, ablation of radiation necrosis...

Placement of Biopsy Needles
Small, deep tumors, brain stem gliomas...

Placement of Drug Delivery Catheters
Clinical trials, research...

Courtesy of Drs. Starr, Larson, and Martin, UCSF; Dr. Chen, UCSD; and Dr. Robert Gross, Emory
ClearPoint – Seeing is Believing

Real-Time, MRI Guided, Minimally Invasive Neurosurgical Procedures

Visualization
• Accurately locate target
• Account for shifts in anatomy

Verification
• Observe progression of the device in real time
• Adjust and react to events as they occur

Confirmation
• Confirm precise placement of device or instrument
• Achieve submillimetric accuracy

In your existing diagnostic MRI scanner
ClearPoint Installed Base – 37 and Growing

35 U.S. installations, 2 in Europe
**Clinical Experiences with ClearPoint**

*Seeing is Believing…*

Because we can use real-time image guidance during the procedure, we generally can place the electrodes with just one penetration of the brain.

- Dr. Paul Larson, Neurosurgeon, UCSF | SmartPlanet

[Interventional MRI] allows us to take into account brain shift . . . we’re very concerned about changes in distances of a millimeter or two. These can be critical. So we really want that error to be on the order of no more than a millimeter. And the interventional MRI technique allows us to achieve that and allows us to verify that we’re within that millimeter of the chosen target in real time.

- Dr. Mark Richardson, Neurosurgeon, UPMC | Ivanhoe Newswire

. . .having ClearPoint to assure accuracy was critical to successful ablation of the tumor . . .

- Dr. John Honeycutt, Neurosurgeon, Cook Children’s Hospital

ClearPoint allows me to surgically treat patients I would not be able to treat using other platform systems.

- Dr. Hooman Azmi, Neurosurgeon, Hackensack Univ. Med. Center

Interventional MRI-guided neurosurgery . . . has tremendous potential for the delivery of devices to deep brain targets.

- Dr. Phil Starr, Neurosurgeon, UCSF
Building Your Business

ClearPoint Technology

Hospital Marketing

Practice Building

TV

Web

Print

An Innovative DBS System for Parkinson’s

Referring Physician Education

Patient Outreach by Neurosurgeon
Evolution Toward the Neurosciences Center

Moving your practice to the next level to compete in an evolving neuroscience market

Placement of...
- Electrodes
- Laser Ablation Catheters
- Drug Delivery Catheters
- Biopsy Needles

Hospital Neuroscience Programs
- Tumor
- Epilepsy
- Movement Disorders
- Drug Delivery
- Advanced Research
ClearPoint Neuro Navigation System

*Research with ClearPoint*

**Clinical Research**
ClearPoint is being used in Six Phase I Investigational Drug Clinical Trials*

**Preclinical Research**
Preclinical research at UCSF, Emory, Colorado State, Oregon, UPMC and Northern Biomed
Fixation frames available for multiple large animal models (non-human primates, pigs, dogs, sheep)

*Seeing is Believing*

*SmartFlow Cannula is approved for injection of Cyterabine or removal of CSF from the ventricles during intracranial procedures. Uses other than the approved indication are limited by Federal law to investigational use.*
Economics of ClearPoint

Increase Revenue
Opportunity to reach additional patient populations that may otherwise forego surgery
Subsequent revenue from follow up visits

Decrease Costs
Minimally invasive procedure
Efficient workflow
Move procedures from the more expensive OR to the less expensive MR suite

Improved Utilization of Existing Infrastructure
1 hour of MR Scanner time used for diagnostic imaging could generate $725 *
1 hour of MR scanner time used for a ClearPoint procedure could generate $5,150 **

* Estimated average US hospital-based MRI suite revenue per hour for diagnostic scans, based on data gathered by MRI Interventions. Excludes professional fees. Actual revenues will vary by site and procedure. It is the responsibility of the provider to determine coverage and to submit appropriate codes, modifiers and charges for services rendered.

** Based on the FY 2014 Medicare National Average payment for an inpatient electrode implantation under MS-DRG 025. Assumes 5 hour procedure duration. Excludes professional fees. Actual revenues will vary by site and procedure. It is the responsibility of the provider to determine coverage and to submit appropriate codes, modifiers and charges for services rendered.
MRI Interventions

- Founded in 1998 as a pioneer in interventional MRI
- Leader in real-time MRI-guided interventions
- Extensive patent portfolio; 95+ patents / 95+ pending apps

Strong Clinical Specialist Team

Clinical Manager Dr. Tim Goble has supported 500+ neuro-surgical procedures

Tim Goble, PhD, MBA
Director of Clinical Operations

Local clinical specialists provide training and case support

Comprehensive Support

Installation

Training

Case Support
Managing the Logistics of the Process

*Partners Every Step of the Way*

Initial Introduction to key stakeholders (Neurosurgery, Radiology, etc.)

Evaluation of MR scanner suite and committee review

Capital purch. or eval agreement

Installation, Training, Case Support

The MRI Interventions Sales and Clinical Support Team will walk with you through every step of the ClearPoint process.
ClearPoint – Seeing is Believing

**Real-time Image Guidance for Minimally Invasive Neurosurgical Procedures**

**Visualization**
See the target and plan the trajectory using real-time images

**Verification**
Observe progression of the device in real time

**Confirmation**
Confirm accurate placement of instrument or device *before* closing

**ClearPoint...**
- Enables *submillimetric* accuracy in minimally invasive procedures
- Enables minimally invasive neurosurgery through entry points as small as 3.2 mm
- Facilitates a variety of minimally invasive neurosurgical procedures
- Works in a hospital’s existing diagnostic scanner
- Is easy to implement
  - Full MRI Interventions clinical support present at all cases
- Frees up OR for additional revenue-generating activities
- Increases MRI revenue
- Increases utilization of current infrastructure

Delivering Confidence.
Real-Time Image-Guided Minimally Invasive Procedures

...applied across multiple medical specialties

- Cardiovascular
- Abdominal
- Orthopedic
- Spine

Being applied in neurosurgery today...

"The move to real-time, MRI-guidance for minimally invasive neurosurgical procedures is inevitable...“

Prof. Stephan Chabardes, Universite Joseph Fourier Hospital

How do we move forward with you?
Next Steps – Key Players

<table>
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<tr>
<th>Applications</th>
<th>Neurosurgeon</th>
<th>Est. Cases/Year</th>
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<tr>
<td>Electrode Placement</td>
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<td>Drug Delivery</td>
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Appendix

ClearPoint Products
Clinical Evidence
ClearPoint Software
ClearPoint Literature

“Seeing is Believing”
ClearPoint Neuro Navigation System

ClearPoint Draping in Preparation for a Case in a Diagnostic MRI Suite
ClearPoint Sterile Draping System for MRI Scanners

• The ClearPoint system has a variety of sterile drape configurations designed to be compatible with the most widely used MRI scanners.

• The ClearPoint sterile drape system received 510(k) clearance for use during surgical procedures conducted under MRI imaging.

• The ClearPoint drape provides a sterile covering between incision and MRI scanner.
ClearPoint Neuro Navigation System

Selected ClearPoint Disposable Components
SmartFrame® XG TwistPoint System

Twist Drill Access

Broadening Applications - Reducing Entry Size

- SmartFrame Mounts Directly on Scalp
- 3.2 mm Twist Drill
- Exchangeable Guide System
- Small Stab Incision

For Biopsies and Catheter Placements

click to play
SmartFrame® XG System

- Minimally Invasive Twist Drill Access
- Precision Device Delivery
- Delivers a Range of Devices

SmartFrame XG Exchangeable Guides

- New Removable Cap
- Exchangeable Targeting and Delivery Guides
- Various Sizes

TwistPoint Workflow

1. Attach Scalp Mount Base
2. Attach SmartFrame® or SmartFrame® XG
3. Create Twist Drill Hole

Appendix
Small Incision Scalp-Mount Approach

- Small scalp incision
- Suture down scalp opening
- Use standard burr hole ring and lock

- Attach SmartFrame Scalp Mount Base and Trajectory Guide
- Complete electrode placement procedure
SmartFlow® Neuro Ventricular Cannula

The SmartFlow neuro ventricular cannula is an MRI compatible injection and aspiration cannula and it is indicated for injection of Cytarabine or removal of CSF from the ventricles during intracranial procedures. The inner lumen is designed to allow low priming volumes minimizing therapeutic agent waste.

- Low priming volume
- Multi-step tip design
- Ceramic cannula body encased within a protective outer polymer sleeve
- Four configurations - two gauge sizes each with a short or long extension tube

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Cannula Outside Diameter</th>
<th>Total Cannula Length*</th>
<th>Inner Lumen I.D.</th>
<th>Total Length</th>
<th>Priming Volume</th>
<th>Injection Flow Rates**</th>
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<td>(ga) (in.) (mm)</td>
<td>(in.) (cm)</td>
<td>(in.) (µm)</td>
<td>(ft) (cc)</td>
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*Total Cannula Length Includes Hub

** Injection flow rates were a result of bench testing at room temperature, using a 120 mg/ml solution of Cytarabine and a 5 cc BD disposable syringe.
Head Fixation Options

Two Fixation Frame designs are available to best suit your applications.

- **Fixed** Fixation Frame- for ease of patient fixation allowing top of head access
- **Adjustable** Fixation Frame- for a wider variety of head access, including prone positioning
- Both frames mount directly to scanner bed and are compatible with scanner specific flexible imaging coils

Available for all major scanner manufacturers.
ClearPoint Software

• Intuitive, menu-driven software for surgical planning, navigation to target and device delivery.
• Streamlined workflows and user flexibility simplify frameless stereotactic procedure.
• Using intraprocedure MR images and coordinates, the software provides navigational instruction to reach the target with a high degree of precision.
ClearPoint Software 1.5

- Features ease of use for planning entry and target point
- Includes pre-op planning module

- Allows for saving multiple plans and import at time of surgery
- Improved views during all phases of procedure
- Designed to accommodate multiple patient positions for a range of neurosurgical procedures
Scan Plan Parameters

Adjust the pitch and roll, then repeat the scan. Continue until the canula is pointing at the target.

Appendix
Brain Shift During Neurosurgical Procedures

ClearPoint Targeting Accuracy

An Optimized System for Interventional Magnetic Resonance Imaging-Guided Stereotactic Surgery: Preliminary Evaluation of Targeting Accuracy

BACKGROUND: Deep brain stimulation electrode placement with interventional magnetic resonance imaging (MRI) has been reported using a commercially available skull-mounted aiming device (Micromedex NeuroFrame) and native MRI scanner software. This first-generation method has technical limitations that are inherent to the hardware and software used. A novel system SurgiVision ClearPoint consisting of an aiming device (SMARTFrame) and software has been developed specifically for interventional MRI, including deep brain stimulation.

OBJECTIVE: To report a series of phantom and cadaver experiments performed to determine the capability, preliminary accuracy, and workflow of the system.

METHODS: Eighteen experiments using a water phantom were used to determine the predictive accuracy of the software. Sixteen experiments using a human cadaver phantom were used to determine targeting accuracy of the stereotactic burr holes in cadaveric heads performed to compare the preliminary accuracy of ClearPoint with NeuroFrame MRI.

RESULTS: Software prediction experiments showed an average error of 0.9 ± 0.5 mm in magnitude in pitch and roll (mean pitch error, -0.2 ± 0.7 mm; mean roll error, 0.2 ± 0.7 mm) and an average error of 0.7 ± 0.3 mm in X-Y translation with a slight anterior (0.5 ± 0.3 mm) and lateral (0.4 ± 0.3 mm) bias. Targeting accuracy experiments showed an average radial error of 0.5 ± 0.3 mm. Cadaver experiments showed a radial error of 0.2 ± 0.1 mm with the ClearPoint system (average procedure time, 88 ± 14 minutes) vs 0.6 ± 0.2 mm with the NeuroFrame MR (average procedure time, 92 ± 12 minutes).

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Phantom experiments radial error: 0.5 ± 0.3 mm
Cadaver experiments radial error: 0.2 ± 0.1 mm
ClearPoint Navigation for Biopsy

Images courtesy of Dr. Clark Chen, UCSD
Minimally Invasive MRI-Guided Neuro Navigation Platform

MRI Interventions’ ClearPoint® platform provides real-time intraoperative MRI visualization for minimally invasive neurosurgical procedures. The ClearPoint system has a very high degree of precision and accuracy. The ClearPoint system has been designed to simplify traditional stereotactic procedures.

Platform for Multiple Procedures. The ClearPoint platform enables the delivery of a wide range of therapies for a variety of neurological diseases and disorders by aiding in the placement of

- Electrodes
- Catheters
  - Laser Ablation Catheters
  - Drug Delivery Catheters
- Biopsy Needles

Minimally Invasive. The ClearPoint system enables minimally invasive frameless procedures and allows for a less invasive approach by using scalp mount and twist drill access technology.

Flexible Platform. The ClearPoint system is a flexible platform that easily integrates with a hospital’s existing 1.5T and 3T diagnostic or intraoperative scanner.

TRANSFORMING NEUROSURGERY
Simplifying Stereotactic Procedures

SmartFrame® Device - Small adjustable skull-mounted or scalp-mounted stereotactic trajectory guide for device insertion. Four degrees of freedom, large range of motion, and slim profile allow two frames to be mounted simultaneously for bilateral procedures.

SmartFlow Cannula® - MRI compatible neuro ventricular cannula is designed for accurate and reliable delivery*. The multi-step tip is designed to minimize retrograde flow and the unique tubing design provides low priming volumes.

ClearPoint Software - Intuitive, menu-driven software for surgical planning, navigation to target and device delivery. Using intraprocedure MR images and coordinates, the software provides navigational instruction to reach the target with a high degree of precision.

ClearPoint Hardware - A variety of fixation frames are available for all major scanner manufacturers. Also available are adjustable table mounts allowing for flexibility in patient positioning.
Minimally Invasive MRI-Guided Neuro Navigation Platform

MRI Interventions’ ClearPoint® platform provides real-time intraoperative MRI visualization for minimally invasive neurosurgical procedures. With its high degree of precision, the ClearPoint system was designed to simplify traditional stereotactic procedures.

The ClearPoint Biopsy Advantage

- Real Time Visualization of Target
- Optimized Trajectory Planning
- Submillimetric Accuracy
- Visual Confirmation of Biopsy

Minimally Invasive with SmartFrame® XG and Twist Drill Access. A small stab incision and a 3.2 mm twist drill together with the SmartFrame XG and Ad-Tech® MRI conditional biopsy needle provide the perfect minimally invasive MRI-guided biopsy solution for neuro applications.

Transforming Neurosurgery
Seeing is Believing
Designed for Accurate and Reliable Performance

The SmartFlow® neuro ventricular cannula® is an MRI compatible injection and aspiration cannula and it is indicated for injection of Cytarabine or removal of CSF from the ventricles during intracranial procedures. The inner lumen is designed to allow low priming volumes minimizing therapeutic agent waste.

- Low priming volume
- Multi-step tip design
- Ceramic cannula body encased within a protective outer polymer sleeve
- Four configurations - two gauge sizes each with a short or long extension tube

For Low Priming Volumes the Silica Inner Lumen Extends Throughout Length with a 3mm Promising Tip and Soft Polymer Extension Tubing for Protection
The SmartFlow® neuro ventricular cannula is designed for optimal performance.

- Low priming volume
- Multi-step tip design
- Ceramic cannula body encased within a protective outer polymer sleeve
- Four configurations - two gauge sizes each with a short or long extension tube

### Technical Specifications

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*Total Cannula Length includes Hub

**Injection flow rates were a result of bench testing at room temperature, using a 120 mg/ml solution of Cytarabine and a 5 cc BD disposable syringe.
MRI-Guided Neuro Navigation Platform

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“Seeing is Believing”

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ED-201278 Rev 02 10/2014