

Clinical Accuracy of Automatic vs. Surface Matching Registration



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Products

Universal AIR; Surface Matching Registration; Spine Navigation; Curve (Dual)

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Clinical Background

Traditional freehand spine surgery involves estimating screw trajectories by exposing anatomical landmarks which leads to significant tissue trauma, particularly in patients with altered anatomy. The introduction of modern navigation techniques - which require registration - has improved overall accuracy, allowing for minimally invasive surgery (MIS). Registration processes are complex and maintaining accuracy presents a challenge. Traditional *Surface Matching* registration is a manual method that matches the patient's anatomy to preoperative image data. However, the manual process can be cumbersome and prone to user error. An alternative is Automated Image Registration (AIR) with scanner independent Universal AIR matrices. This method could overcome these drawbacks and offer increased registration accuracy and user independence by employing intraoperative 3D imaging-based registration.

Study Objectives

The aim of the study was to compare Universal AIR registration accuracy and workflow to that of traditional Surface Matching registration and in turn, assess potential benefits of automatic image registration in thoracolumbar spine cases.

N = 39 patients (42 datasets); prospective, interventional, non-randomized study

Results

- **Registration accuracy (= target registration error):**
 - Universal AIR: $1.20 \pm 0.42 \text{mm}$
 - Surface Matching: $1.94 \pm 0.64 \text{mm}$
 - **Difference: -0.74mm**
- **Registration comparison:**
 - The results confirmed the hypothesis that Universal AIR registration accuracy with CBCT (Medtronic O-Arm) imaging is non-inferior to Surface Matching registration accuracy
 - Post hoc analysis showed even significantly better registration accuracy for the automatic registration
- Good workflow feasibility with O-Arm scanner and Universal AIR positioning
- Simultaneous detection of different reference markers might be challenging (especially with the infrared camera looking "through" O-arm gantry)

Summary

- Universal AIR has **significantly better registration accuracy** compared to Surface Matching and **eliminates outlier/user error**
- Surface Matching accuracy is **still clinically acceptable** ("perfectly fine") especially if the user is familiar with this method
- **Workflow is perfectly feasible with O-Arm**, all patients were successfully registered
- **This is the first publication** to quantify and compare accuracies of registration methods

General notice: Selecting a registration method is a critical step, as both methods have pros and cons depending on the clinical situation, e.g. although Surface Matching does not work for MIS cases, it provides intra-op radiation-free registration with sufficient clinical accuracy, particularly helpful in cases with highly mobile anatomy where re-registration would be indicated.