Importance of Device Sizing and Positioning in Total Disc Replacement Surgery

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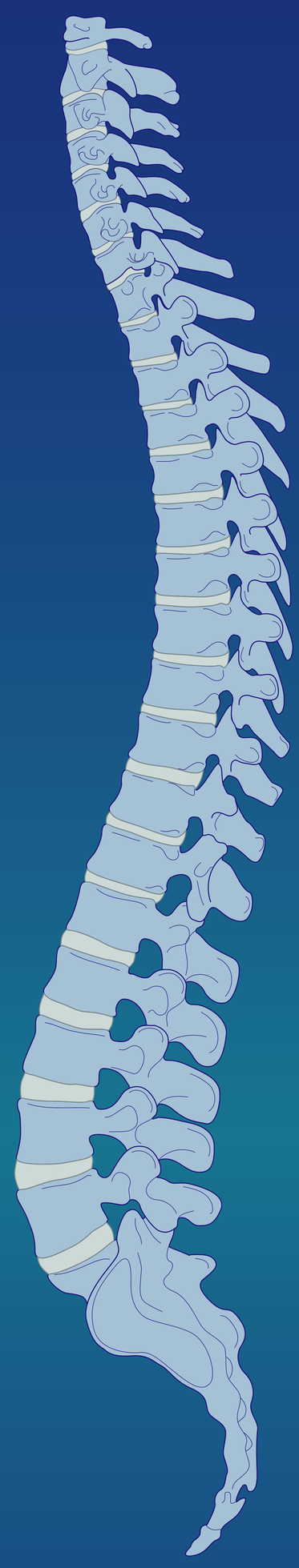


Learning Objectives

1. Artificial disc replacement as an alternative to spinal fusion requires correct insertion into the intervertebral space.
2. Malpositioning and improper disc sizing may lead to complications from undesirable loading, disc migration, core displacement.
3. Careful preoperative planning is paramount to reduce the need for future revision.
4. A novel system for accurate artificial disc placement is presented to achieve proper positioning and disc sizing. process and altered segment biomechanics.

PRESENTATION DESCRIPTION

Introduction

A key issue in artificial disc replacement surgery is the need to insert the disc assembly into the correct position between the two adjacent vertebrae, such that it allows the correct kinematics of the adjacent vertebrae. [1,2,3] Malpositioning and inappropriate sizing may lead to undesired loads at the facet joints and pain[4] which may in some cases limit mobility to such an extent that spontaneous fusion occurs. Malpositioning and inappropriate sizing may predispose to disc migration and/or core displacement with nerve and blood vessel damage. Careful pre-operative planning is therefore paramount to avoiding the need for revision in the future.

4% of patients who underwent Charite artificial disc replacement required disc removal after 2 years of follow up due to disc migration, translation or device displacement from incorrect prosthesis placement. 70% of these patients were converted to fusion.[5]

Discs are particularly sensitive to deviations from the midline in both the coronal and midsagittal planes. For most commercially available artificial discs 2-3 mm deviation from the recommended position is considered malpositioning which might lead to adverse events. Most authors agree that the current surgical techniques may not allow precise control over the location of the implant with respect to the disc morphology.

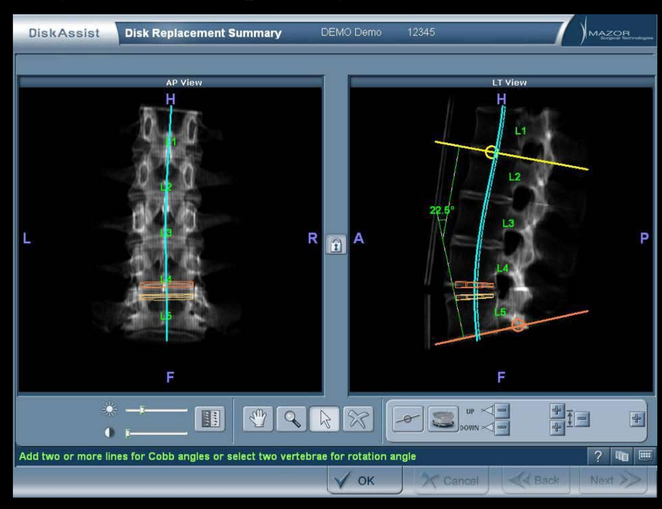
Artificial disc placement affects spinal kinematics and significant deviation from ideal placement greatly increases facet joint loading. Thus, surgical variables may have profound influence on the long-term outcome of an artificial disc. Surgical technical accuracy therefore could offer beneficial clinical outcomes

Method

Cadaveric evaluation of a novel system aimed at precise positioning of an artificial disc relative to its associated vertebrae, and in accordance with a preoperative plan on a CT scan.

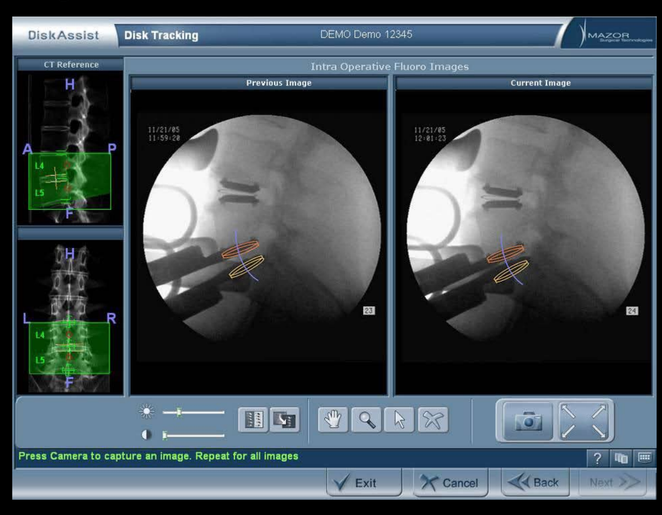
The planning non-vendor specific software was used to generate a pre-operative plan from the CT scan of the subject. Implant position and size - footprint, height and lordotic angle - were examined and measured in all 3 common cross sections (Axial, AP and Lateral), to ensure restoration of optimum lordosis, disc height and alignment. The system generated a dynamic model of the subject's spine on which an artificial disc could be placed. The system simulated the plan on the adjacent levels to determine the lordosis and illustrated a synthetic, simulated view of the spine

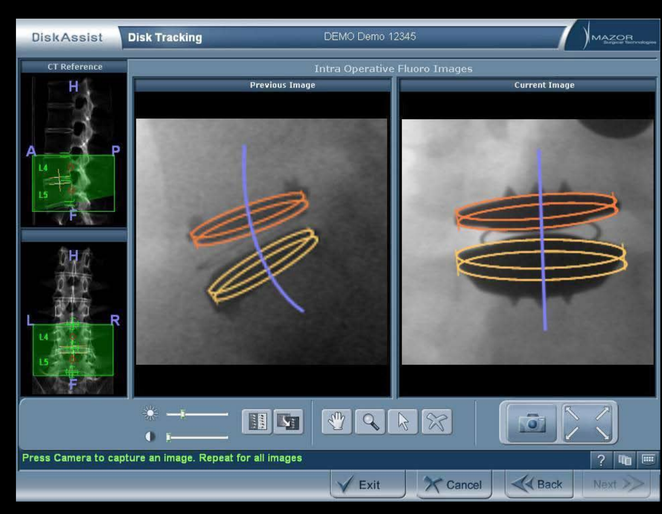
Figures 1 and 2 – planning



Automatic registration during the surgical procedure allowed comparisons between the preoperative CT data and two real-time fluoroscope images – AP and oblique. The desired position of the disc from the pre-operative plan was superimposed on the real-life fluoroscopic images.

Figures 3 and 4 - execution





This technology is currently being evaluated in pre-clinical studies to determine its utility in TDR placement. The system's generic nature, its use of existing tools and C-arms lend it to a wide range of positioning applications.

Conclusion

Malpositioning and improper disc sizing may lead to complications from undesirable loading, disc migration, core displacement.

Using this novel system a surgeon can match the actual position of the artificial disc with that of the preoperatively planned one and correct its placement accordingly without having to change or adjust his surgical technique.

References

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