Evaluating the Effects of Spinal Treatments on the Kinematics of Spine Using a Robotic Simulator

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Introduction

Low back pain and other common spinal disorders are ubiquitous in all industrialized nations with an estimated 70 million Americans affected.

Anecdotal evidence suggests that surgical treatment at one level of the spine may be a stimulus for degeneration at adjacent levels. New dynamic spinal stabilization techniques purport to eliminate this problem. However, the effects of intervention at one level of the spine on adjacent levels has not been quantitatively characterized.

Materials and Methods

1. Collect voluntary motion data from 15 healthy volunteers to map workspace volume via Flock of Birds 3D position and orientation sensors & plain radiographs.

2. Use ROM data collected from subjects to drive a PUMA robot to move excised cadaveric spines through the same motions.

3. Compare motion in live subjects to robot controlled excised spine & validate.

4. Mount excised spine in robot and replicate the motion collected with the volunteers in the validation phase.

5. Perform clinical procedure on cadaveric spines.

6. Mount excised spine after alteration in robot and replicate the motion collected with the volunteers in the validation phase.

7. Observe the comparative changes before and after intervention at the non-operative spinal levels.

Purpose

The purpose of this ongoing study is to characterize the effects of single level spinal intervention on the kinematics of the whole spine using a robotic spine motion simulator.

Discussion

A better understanding of adjacent level effects following surgical intervention of the lumbar spine helps to guide the surgeon in selecting the most appropriate treatment for patients in jeopardy of developing spine pathology at levels adjacent to a surgical intervention. While fusion procedures are likely to exacerbate or accelerate degeneration at adjacent levels, new motion preserving technologies such as total disc replacement or posterior dynamic stabilization are thought to preserve adjacent level kinematics and normal tissue strain. Quantitative comparison of the effects of each technique will provide new insights into the effects of each treatment.

References