Three-Dimensional Measurement of the Stretch and Displacement of the Perineum during Labor using Stereophotogrammetry

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Introduction

- Vaginal delivery is the single modifiable risk factor for the levator ani muscle (LA) injury, and then pelvic organ prolapse and urinary incontinence later in lives. (Dietz and Lanzarone, 2003; Kearney et al., 2006)
- However, objective real-time measurements of the pelvic floor deformation during the late 2nd-stage of labor are lacking.
- The specific factors and cascade of events that lead to the LA injury are still unknown.
- Direct verification of biomechanical computer simulations is not possible, so indirect methods are indicated.

Aims

- Present a novel intrapartum measurement system which features objective yet accurate measurements based on computer vision technology.
- Document the details of the movement of the perineal surface deformation during late 2nd-stage of labor.

Methods

Device design
- A pre-calibrated pair of webcams connected to a laptop
- No external power required
- Hospital electrical safety inspection passed
- Recording and analyzing software written in C++ (OpenCV library) and Matlab, respectively.

Intrapartum measurement
- University of Michigan IRB approval obtained
- Two primiparous women (20 & 32 yo)
- Recorded during the entire 2nd-stage
- Device located at the foot of the bed
- Ink-dotted markers placed on the perineum and vulva

Types of measurement
- Anterior-posterior (AP) and lateral (LA) diameters of the vaginal opening
- Perineal surface deformation - Principal stretch magnitude and direction

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Conclusions

- The ability to measure the changes in complex geometry in real-time should aid efforts to develop strategies to prevent pelvic floor injury.
- Limitations
  - Modest number of subjects participated
  - Rate of stretch ratio was not quantified.
  - Measurement resolution remains to be improved.
- Post-processing of the measurement was required.

Results

Time Course of Diametric Changes (Fig. x)
- Major change concentrated in the final pushing phase
- Diameter changes and the pushing pattern are in phase

Surface Deformation (Fig. x)
- The deformation during the final push is up to twice that of earlier pushes in the 2nd-stage of labor
- Principal stretches are concentrically distributed
- Helpful in differentiating local stretch magnitude and direction
- Spatial resolution of the measurement was adequate

Discussion

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