Improving Accuracy, Precision, and Clinic Visit Time for Ultrasound Length Measurements in Magnetically Controlled Rods

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background

Magnetically controlled growing rods have changed treatment of early onset scoliosis. Ultrasound is used to measure rod lengthening in clinic to decrease radiation exposure for frequent lengthenings.¹ Ultrasound has been established to be as accurate as radiographs.² Accurately determining the amount of lengthening achieved using ultrasound in the clinic setting is challenging on a moving child. The neck of the rod is often difficult to reliably capture and measure. (Figure 1) Obtaining quality images and reproducible points of reference can be difficult and time consuming with the current rod design. The purpose of this study is to determine the speed and accuracy of length measurements using an echogenic marker to create an easily identifiable reference point and improve the clinic visit time for lengthening patients.

![Figure 1. Standard rod with neck (blue arrow) and edge of the housing (white arrow). These are the two areas used to measure lengthenings of magnetic growing rods on radiographs and ultrasound.](image)

methods

This is a translational study with bench and bedside components. Two magnetically controlled growing rods were placed on a spine model with an ultrasound block. One rod had an echogenic marker applied at the slope junction. (Figure 2) The distance from the slope of the control rod and the marker on the experimental rod to the respective actuator was measured using ultrasound. (Figure 3) Six observers performed sixty measurements, thirty with the marker and thirty standard. For the clinical application, thirty-two patients with standard rods and three patients with marked rods underwent timed standard lengthenings in clinic. The rod configuration (standard versus offset) were also compared.

![Figure 2. An Echogenic marker consisting of an 18G wire and a 5mm 20F chest tube was placed at the neck junction (arrow). An ultrasound training model was placed over the rods to obtain ultrasound images.](image)

results

The inter-rater reliability was extremely high for all reads, raters, and across marker groups (K=0.996, 0.995, and 0.996 respectively). The intra-rater reliability was excellent (K >0.992). Accuracy was high among the observers. There was a trend toward faster measurement with the marker but not statistically significant (37s versus 67s). In the clinical setting with standard rod configuration, average time to lengthen was 9.34 minutes, with 68 seconds per rod in an offset rod configuration and 66 seconds per rod in a tandem configuration (p=0.81). With the echogenic marker, average time to lengthen was more consistent (380-560s vs 326-681s) and shorter time to identify the rod and measure by ultrasound.

![Figure 3. Ultrasound appearance of the standard neck of the rod (A) and the echogenic marker (B).](image)

discussion

Use of an echogenic marker may improve clinic time for lengthening rods while minimizing radiation exposure. Our clinic times for lengthening do not currently have statistical power due to small patient numbers in our echogenic marker group. In addition, the patients that do have the echogenic marker all have difficulty sitting still and with attention, making them a more difficult population to image and measure. This simple technique using and echogenic marker can improve efficiency of lengthenings without jeopardizing accuracy of measurements.

![Figure 4. Radiographic appearance of the standard neck of the rod (A) and the echogenic marker (B).](image)

references


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