IS THE iPHONE A USEFUL CLINICAL TOOL TO MONITOR SPINAL DEFORMITY PATIENTS?

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INTRODUCTION

The progression of spinal deformity is traditionally monitored on hard copy radiographs using the Cobb method with a protractor and pencil. The rotation of the spine and ribcage (rib hump) in scoliosis is measured with a hand-held inclinometer/Scoliometer. The iPhone and other smart phones, can accurately sense inclination, and can therefore be used to measure Cobb angles and rib hump angulation. The purpose of this study was to quantify the performance of the iPhone compared to the standard protractor (Cobb angles) and the Scoliometer (rib hump).

METHODS

Seven observers measured major Cobb angles on 20 postero-anterior X-rays of patients with adolescent idiopathic scoliosis (AIS) of varying severities. The X-rays were randomly selected from a spinal deformity database, de-identified and multiple copies printed onto A3 paper. The general spinal region to measure was nominated but vertebral levels were not pre-selected. Cobb angles were determined firstly with the iPhone and then with the protractor. Five of the observers repeated the measurements at least a week later on fresh printouts.
A specialist Orthotist fabricated plaster moulds of the torsos of 8 scoliosis patients and overlaid a 7mm foam layer to mimic the skin surface. The plaster rib humps were numbered 1 - 8 and placed on a bench in random order on 4 occasions, a week apart. Nine observers measured the rib humps with either the iPhone or the Scoliometer each week until all observers had measured the humps twice with each device. For both studies, the observers were unaware of all previous measurements.

RESULTS

A total of 478 Cobb angle measurements were made. The overall mean Cobb angle was 45° (range 15-72). The mean time for an observer to measure the 20 Cobb angles was 19 minutes (range 15-23) with the iPhone compared to 22.5 minutes (range 18-27) with the protractor. The mean absolute difference between pairs of iPhone and protractor Cobb measurements was 2.1° with a small bias (1°) toward lower Cobb angles with the iPhone. The mean absolute intra-observer variability was 2.1° for the protractor and 2.3° for the iPhone. The inter-observer error for Cobb angle measurements was 4.0° for the iPhone and 3.4° for the protractor. A total of 266 rib hump measurements were made. The overall mean rib hump was 16° (range 6-30). The mean absolute difference between pairs of iPhone and Scoliometer measurements was again 2.1° with a bias of almost 1° toward higher rib hump measurements with the iPhone. The mean absolute intra-observer variability was 0.9° for the Scoliometer and 2.2° for the iPhone. The inter-observer error for rib hump measurements was 2.0° for the iPhone and 1.4° for the Scoliometer.

DISCUSSION

The iPhone has the potential to be useful in spinal clinics as well as remote areas where hospital PACS systems or the appropriate computer measurement tools are not always available. The iPhone is a clinically equivalent measuring tool to the traditional protractor and Scoliometer, with inter and intra-observer variability similar to the protractor and Scoliometer and previous studies of manual measurement techniques.

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