Validation of a Bilateral Weight Scale as an Assessment Tool in a Chiropractic Research Laboratory

Dennis Nosco, Ph.D., **Jeff Birkenmeier**, B.S., **Steve Costantino**, B.S., and **Raymond A. Wiegand**, D.C., Logan College of Chiropractic

Bilateral weight scales were developed by chiropractors to measure balance in their patients. It has been part of chiropractic culture that if subluxation is a major problem and is corrected to a significant degree, the patient will normally have better balance. Two papers have been published, though none recently, describing bilateral (or 4-quadrant) weight scale validation as it relates to obtaining a reproducible and reliable measurement on the patient. However, no papers have been published that deal with the validation of the actual operation of the scales. Before any tool is used to make predictions about the results of chiropractic research or care, the instrument should be validated to demonstrate that its results are actually usable. The following student research project, done at Logan College of Chiropractic, describes one such validation of a weight scale used in the college's research department.

MATERIALS AND METHODS

The Chirotron model 6800 Weight Analyzer (Chirotron, Seattle, WA) contains six separate force plates, two for the front of each foot and one for each heel. The scale averages readings for 8 seconds during the measurement. It presents a printout showing total weight, weight in each quadrant, percent weight shift from neutral LR and AP and the ratio of LR to AP. The scale, which is essentially a 4-way weight scale, was tested for accuracy, precision, sensitivity, linearity (or operating range), reproducibility, and system suitability (including ruggedness), using a combination of precalibrated free weights and human subjects. The human subject research required an IRB approval, which was obtained. The data were treated with appropriate statistical treatments.

RESULTS

It was found in a small trial that with human subjects the optimal time to make a balance measurement using this scale is around 20 seconds. The main error observed for each plate is an electronic rounding error of 1 pound per force plate, which could lead to a maximum error of 7% A/P and 10% L/R error. Standard deviations from repeated measurements set the actual standard deviation at <3%, well below the limits for subtle change that occur from artificially inducing small changes in the weight distribution of the subject. All total weight measurements were accurate to the nearest pound, irrespective of rounding errors from the electronics for individual pads. It was found that moving the equipment from one place in the lab to another may introduce additional error, but it was difficult to separate that from error generated by making a single measurement without subject equilibration time.

DISCUSSION

The weight scale used in this study is very accurate for measuring total weight and weight distribution. The linearity of each pad is good at least up to 75 pounds. Rounding errors of 1 pound per plate, if they are additive, could cause relatively large (10–15%) error for 120 to 160-pound individuals, although this is not likely and the standard deviation is more likely the <3% measured in this study. Care should be taken in moving the machine from one place to another and then using it immediately.

CONCLUSION

The weight scale tested in this experiment was shown to be highly accurate and reliable. The electronic averaging may create data scatter in lower weight individuals. However, this could probably be substantially eliminated by repeated measurements or waiting a slightly long time (>20 seconds) before making the measurement after the subject steps on the scale. More detailed subject parameters to ensure that readings obtained are the most diagnostic will be the subject of future experiments on this weight scale.

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