Gait Data Collection Technology: Where are we, where are we going?

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INTRODUCTION

Clinical gait analysis depends upon technology enabling the measurement of human movement. The availability of custom-designed hardware/software solutions has been key to the spread and popularity of clinical gait analysis.

MATERIALS

The current state-of-the-art in gait analysis collection technology allows labs to collect data using high resolution cameras (up to 4 mega-pixels, see figure 1 below), high collection speeds (up to 2,000 Hz), small markers (down to 4mm diameter) and user friendly software that allows collection, processing and generation of clinical reports to be done in seconds ([1], [2]). A modern lab is able to capture full-body and foot data simultaneously using a large number of small markers, process both the full-body and foot models concurrently and generate a full clinical report long before the patient leaves the lab.

Labs have thus switched their focus from obtaining and processing data to the interpretation. The fact that reports can be generated quickly means that the lab has full confidence in the data quality before the patient leaves. Having to recall the patient because the data turned out to be poor is a thing of the past. In short, the recent increases in camera and software technology has resulted in significant accuracy and time saving gains.

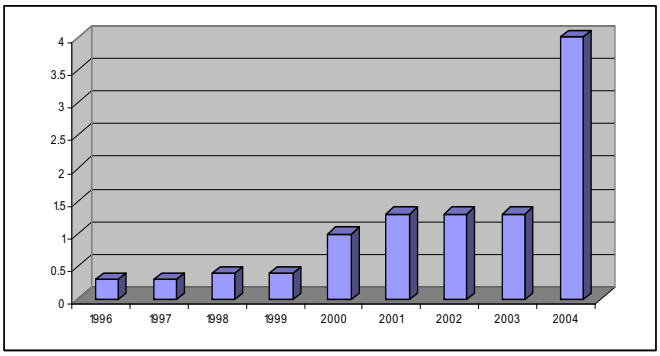

Figure 1: Maximum camera resolutions, in mega-pixels

DISCUSSION

As the attention has switched from the data collection process to the analysis, it is becoming increasingly clear that the improved collection technology exposes shortcomings in the biomechanical modeling phase. Various papers have criticized the current standard, the Conventional Gait Model ([3]). Whereas data collection systems can determine marker centroids to typical accuracies in tenths of millimeters ([4]), the process of transforming these measurements to joint centers, kinematics and kinetics is subject to various sources of errors: soft tissue artifacts, anthropometric measurements that are not subject specific, and inaccurate marker placement with respect to anatomical landmarks.

Solving these problems is currently a hot topic of research ([5]). It can be argued that the manufacturers themselves have done relatively little, although some research and development has taken place ([6]). The future will very likely see more emphasis being placed on the "next generation gait model", both from researchers and manufacturers, and we will see competitive pressures forcing the manufacturers to act.

The main attention must focus on obtaining clinically validated and repeatable results. Manufacturers have to ensure that, whichever biomechanical model and protocol is adopted, the data can be processed through the model with a high degree of automation, confidence and accuracy. To this end, a cooperation between researchers in the gait community and the commercial development departments of manufacturers must be formalized. Also, the manufacturers must recognize that it is in everybody's interest that the implementation of the model is open, published and streamlined – this will give researchers the double benefit of being able to conduct validation easily *and* having full confidence in the results.

Another topic which must be addressed is the financial viability of clinical labs. The manufacturers can address this in two ways: by developing systems that increase the intrinsic value of clinical gait through increased accuracy and standardization, and by developing systems that reduce the time and cost of conducting an analysis session.

As for the technology, initial development will focus on gradually increasing the system's specifications in terms of accuracy and usability. However, the major technology breakthrough in the next 2-3 years is likely to be the development of markerless capture. Although it is too early to predict whether the clinical accuracy requirements will be satisfied, it is obvious that removing the need for markers would bring huge benefits to both patients and operators.

REFERENCES

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