

Gait training enters the high-tech age

By Alberto Esquenazi, MD

In the last 10 years, significant improvements in technology have paved the way for precise, real-time gait analysis viewed across all three planes. At our facility, we rely on sophisticated tools during gait assessments, which allow clinicians to prescribe therapies and orthoses for a range of complications that can hinder gait.

- *Video and the force line.* Video footage captured by two cameras provides a simultaneous side and front view of a patient during ambulation so clinicians can study a patient's gait in slow motion. We also rely on force line visualization, in which a real-time superimposed laser representation allows clinicians to see a force's line of action on the patient during ambulation. One application of this technology is analyzing the effect of adjustments to a patient's prosthesis and braces.

- *Electromyography (EMG).* With EMG, you can evaluate the activity of muscles during walking and stair climbing. Clinicians can record the activity of surface muscles, as well as deep muscles, using fine wire electrodes.

- *Motion analysis systems.* Three-dimensional motion capture analysis is enhanced by sophisticated systems that view simultaneous, bilateral movement with infrared lights and special sensors. Wireless markers permit real-time data processing, and clinicians can interact with patients as they view their own animated walking image.

- *Floor-mounted force plate systems.* As patients walk over an area of the floor equipped with miniature pressure switches, a footfall map is recorded and clinicians can calculate stance, swing, support times, stride length, base of support and other critical measures of a patient's performance.

- *In-shoe pressure sensors.* Patients with insensate feet, which may be due to diabetes or spina bifida, must guard against foot ulcers and infection. With dynamic pressure readings from a thin sensor placed inside the patient's shoe, you can recommend foot orthoses and shoe modifications, and make other adjustments to redistribute pressure.

But the high-tech age of gait analysis arrives at a cost. As these sophisticated advances make their way into motion analysis labs, space requirements are becoming a concern, not to mention the high cost of the equipment. Establishing a well-equipped gait laboratory can be a challenge for many facilities.

To combat these pressures, many clinics are seeking self-contained, cost-effective alternatives. With the assistance of electronics and engineering firms, our clinical team has participated in testing and designing an instrumented treadmill equipped with two independent force platforms and two rolling belts. These components can be controlled by a computer. The main feature of this system is that it allows different speeds for each lower limb, while collecting force plate data.

When combined with a portable opto-electronic active marker system to collect 3-D motion data, you can accommodate the patient's natural walking speed and gait pattern without forcing a symmetrical gait.

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