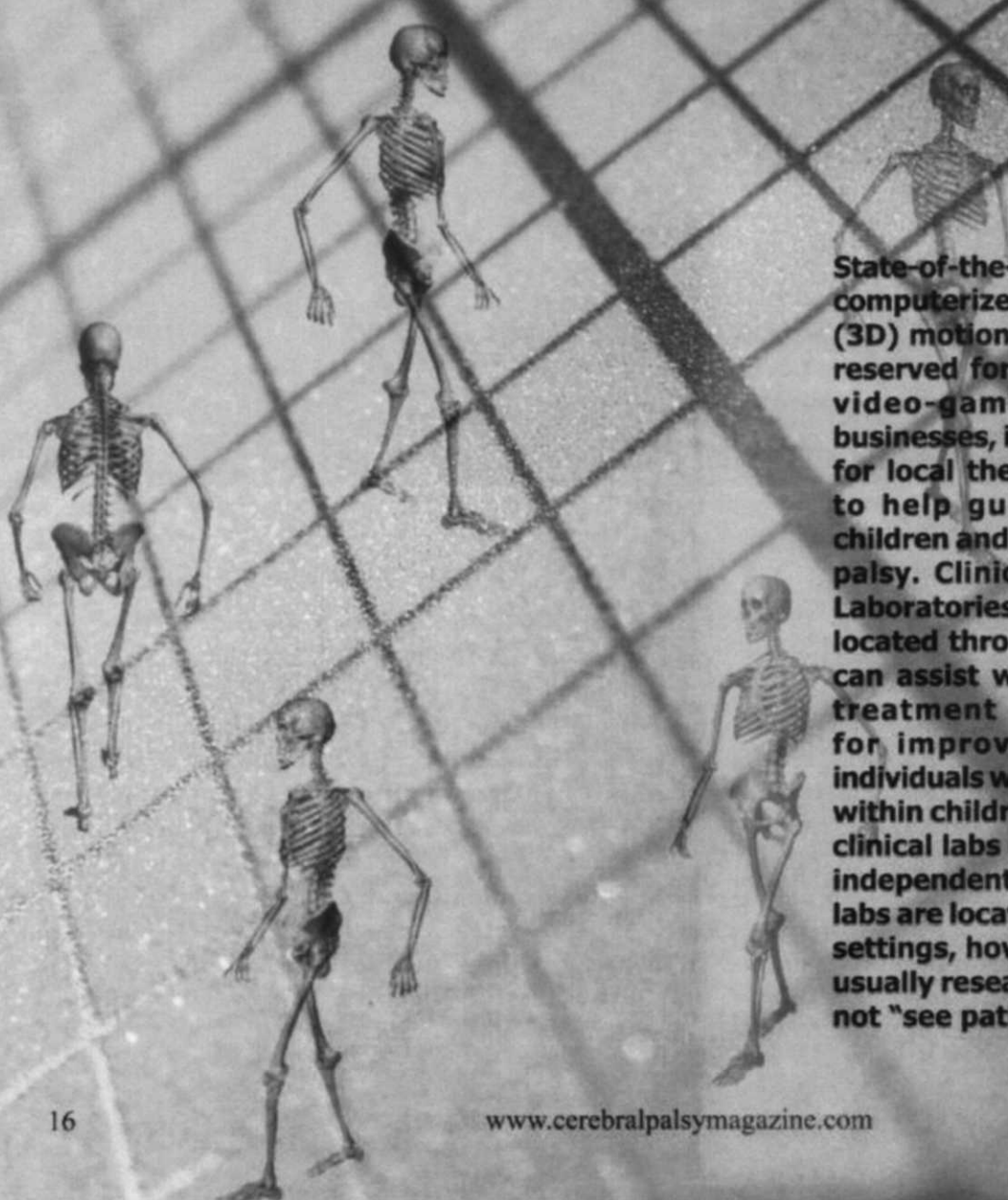


Using Motion-Capture Technology to Guide Treatment in Cerebral Palsy

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State-of-the-art technology using computerized three-dimensional (3D) motion analysis is not only reserved for Hollywood movies, video-gaming, or high-tech businesses, it is also within reach for local therapists and doctors to help guide treatment for children and adults with cerebral palsy. Clinical Motion Analysis Laboratories (MALs), which are located throughout the country, can assist when navigating the treatment options available for improving movement in individuals with CP. Often housed within children's hospitals, these clinical labs can also be found at independent sites. Many motion labs are located within university settings, however these labs are usually research-oriented and do not "see patients."

Gait Analysis

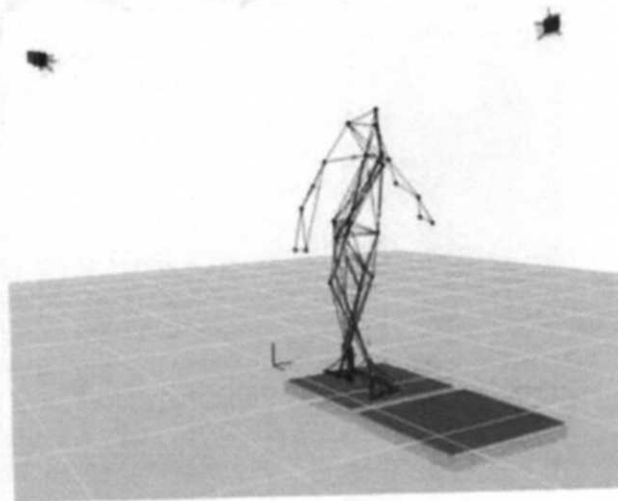
Using evidence-based practice and cutting edge motion-capture technology, physical therapist movement specialists, kinesiologists, bioengineers, physical medicine & rehabilitation doctors and pediatric orthopedic surgeons evaluate movement in a comprehensive way using computerized 3D motion analysis. Both walking (gait) patterns as well as hand and arm (upper limb) movements can be evaluated in the MAL, although not all labs do upper limb analysis.

In the MAL, physical therapists place a myriad of special reflective markers (using stickers) and sensors on an individual's body at strategic anatomic points. Large amounts of information are then collected by cameras mounted on the walls when the individual either walks down a walkway across force plates embedded into the floor (for gait analysis), or performs functional tasks using both hands (for upper limb analysis). This data consists of *kinematics* (3D movement at each body joint), *kinetics* (forces responsible for joint movement), and *electromyography* or EMG (muscle activity related to joint movement).

The evaluation also includes a detailed physical therapy baseline examination done the same day. During this exam, physical therapists measure joint range of motion, muscle length and strength, classify muscle tone (spasticity, dystonia, athetosis, ataxia, or combinations), perform other neurological and orthopedic screening tests, and



Computerized 3D motion analysis at work





classify walking and functional status using standardized scales. By combining the dynamic motion data together with the physical therapy exam findings, a complex picture is created, like a very big jigsaw puzzle. It is not until the puzzle is completely assembled that the complete picture of an individual with CP can be seen – how he or she moves and why that person moves in a certain way. The “fully-assembled puzzle” combines all data in the form of graphs, along with an interpretation that logically lists treatment options, based on the data gathered.



While only a highly-trained clinician with motion analysis expertise can interpret and assemble the motion analysis evaluations, the final written report contains recommendations for the treating therapist, and/or physician. The two to three-hour long evaluation sessions consist of the most comprehensive services available to gather the evidence necessary to make the best decisions for improving movement and function in patients with CP. While many insurance companies cover motion analysis for the diagnosis of CP, a few companies continue to incorrectly insist that motion analysis technology is only a research tool.



Laura is a beautiful 8-year-old girl with CP affecting her left side. She had recently returned to the spasticity clinic at her local hospital for a multi-disciplinary approach to improving her gait. Laura had been seen in the motion analysis laboratory two years prior for both upper limb and gait evaluations. However, her gait

When selecting a motion analysis lab, you can ask about gait and upper limb analysis, if you are interested in both. You can also ask if a “new generation” foot model will be used, which looks at both hindfoot and forefoot motion. If you are an adult seeking a motion analysis evaluation, you need to make sure the lab you choose will see adults. Some health care providers advertise “motion analysis” or “gait analysis” when they are only using conventional videotaping on a treadmill. While these applications may work for a healthy runner, or a straightforward orthopedic injury, computerized 3D motion analysis is necessary to evaluate individuals with CP. In the near future, motion analysis laboratories will be accredited through the Commission for Motion Laboratory Accreditation, Inc. (www.cmlainc.org) after meeting all requirements including submission of an extensive application packet.



pattern had changed considerably since that evaluation, as she had subsequently undergone two rounds of Botox injections, casting, and aggressive physical therapy including kinesiotaping and functional weight-bearing activities. During her appointment, consideration was given to orthopedic surgery, rhizotomy, more Botox and casting, or more physical therapy. When the team members - who included a physiatrist, neurosurgeon, nurse practitioner, neurologist, orthopedic surgeon, and two physical therapists - could not agree on the best course of action to improve Laura's gait, her doctors decided to "level the playing field" and reevaluate her gait in the lab.

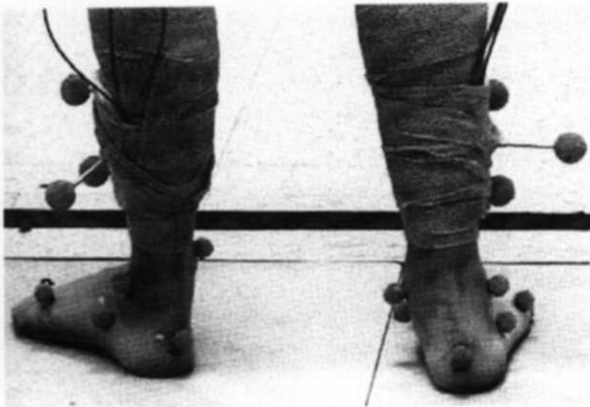


The findings demonstrated multiple improvements in her gait, including a reduction in toe-walking, a change in foot posture, and improved balance.

Evaluations such as Laura's prove instrumental in determining which treatment options not to pursue,

because certain options may cause more harm than good. In Laura's case, secondary dystonia (a specific type of increased muscle tone) was more pronounced than her spasticity, so it was determined that she was not a candidate for rhizotomy surgery, and that tendon transfers were not indicated at the present time. Additional interventions to be avoided, according to the motion analysis data, included surgical hamstring lengthening, or any more Botox to her calf muscles.

Treatment options resulting from Laura's repeat gait analysis included Botox to her ankle muscles, continuation of aggressive and targeted physical therapy including trials with electrical stimulation and continued kinesiotaping, continued daytime use of her orthosis, and consideration of medication trials to manage her dystonia if desired by her parents. Re-evaluation in the motion analysis lab was recommended in 1-2 years to compare results again, and determine the next course of action for Laura.



You can access sample Motion Analysis reports online at <http://biomotionlabs.com> or <http://www.childrenshosp-richmond.org/CMS/index.php/services/motion/>.

For information about the Gait and Clinical Movement Analysis Society, see www.gcmas.org.