

Children's Hospital

MOTION ANALYSIS LABORATORY



What is Motion Analysis?

Evaluating a person's pattern of walking or movement is difficult by observation alone. Opened in 1988, the Motion Analysis Laboratory at Children's Hospital combines state-of-the-art equipment, software, and a specialized professional staff to provide precise measurement and descriptions of movement. A patient's movement pattern can be objectively documented, providing valuable information for patient management.

Who can it help?

Motion analysis assists physicians and therapists in assessing functional problems resulting from:

- ◆ Amputation
- ◆ Arthritis
- ◆ Cerebral Palsy
- ◆ Congenital Abnormalities
- ◆ Brain Injury
- ◆ Movement Disorders
- ◆ Muscular Dystrophy
- ◆ Spina Bifida
- ◆ Peripheral Nerve Injury
- ◆ Spinal Cord Injury
- ◆ Stroke
- ◆ Traumatic Joint or Limb Injury

What does the test involve and how long will it take?

The physical therapist will evaluate the patient's range of motion, flexibility and muscle function at the beginning of the test. Then the patient walks up and down a walkway. While walking, computers collect data of the patient's motion from reflective markers, muscle activity from electrodes, and the interaction with the ground from force plates and foot switches. We will also videotape the patient's walking throughout the test. Frequent rest periods are provided. The entire test takes from two to three hours depending on the patient's particular problem and the





information requested by the physician.

A complete evaluation is comprised of a number of tests performed in a single visit.

Data collection may include:

Physical Evaluation including passive range of motion, specific manual muscle tests, muscle length tests, and selected neurologic & orthopaedic screens.

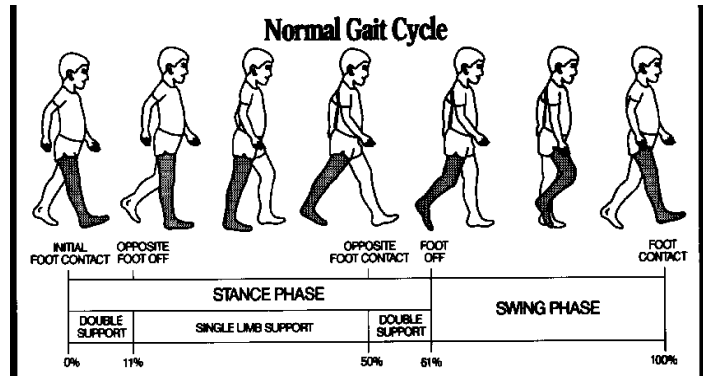
Videotape recordings of front and side views of movement for qualitative analysis.



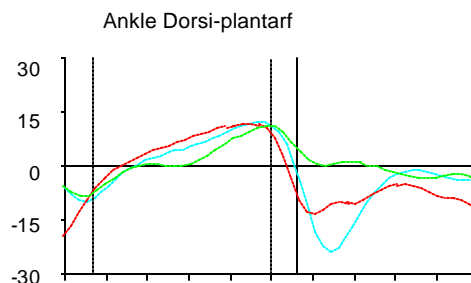
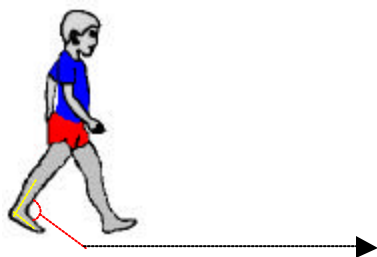
Spatial & Temporal Parameters of the walking cycle.

Typical measures include:

- Velocity
- Cadence
- Stride Length
- Stance
- Swing
- Double Limb Support
- Single Limb Support
- Step Length
- Step Width
- Step Time
- Stride Time



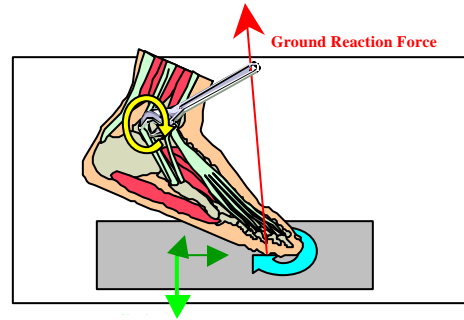
Kinematics – Movements of the lower extremities during gait are quantitatively described using calibrated cameras to record locations of reflective targets on specific anatomic landmarks. A three-dimensional model of the patient is derived from this data for each 120th of a second, which permits precise measurements of the movement of the lower extremities in the sagittal, frontal & transverse planes. The comparative graph below illustrates ankle dorsiflexion and plantar flexion with an ankle foot orthosis (green line) and barefoot (red line). Improved foot clearance in swing is documented with the AFO as the ankle is maintained in a neutral position.





Kinetics

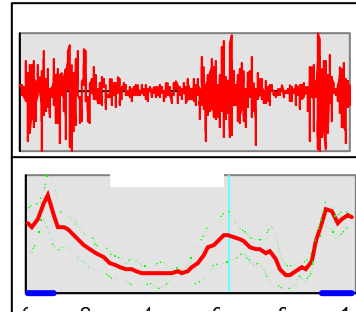
- **Ground reaction forces** – Force platforms imbedded in the lab's walkway measure ground reaction forces (comprised of vertical, fore/aft & medial/lateral shear components) which are external forces from the ground that act on the body during gait. (Newton's 3rd Law.)
- **Center of pressure** – Location that the GRF acts on the body during gait. Determination of center of pressure excursion patterns helps determine weight-bearing avoidance problems.
- **Joint moments** – Studying joint moments can identify the net muscle action occurring about a joint.
- **Joint powers** – The contribution of different muscle groups used to propel the body forward are calculated. Joint powers can identify the type of net muscle contraction (concentric vs. eccentric).



Functional electromyography (EMG) – Utilizing electromyography, the phasic activity of selected groups of muscles can be studied. Surface electrodes are used to record the activity of muscles close to the surface of the skin.

Typical muscles studied with surface electrodes

Gluteus Maximus	Vastus Medius
Gluteus Medius	Semitendinosus
Adductor Longus	Biceps Femoris
Rectus Femoris	Anterior Tibialis
Vastus Lateralis	Medial Gastrocnemius



Fine wire electrodes are used, if necessary, to record small muscles or muscles deep within the limb. Typically studied muscles are posterior tibialis, peroneus longus, toe flexors or extensors.

Results

The comprehensive report includes a physical therapy evaluation, graphic representation of all the data collected, written interpretation of the movement patterns, a summary of the analysis, and recommendations for therapeutic, medical or surgical intervention.

The motion analysis laboratory staff members are available for discussion of the report with the physician or physical therapist.



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Patient Referral:

What is needed to refer a patient to the Motion Analysis Laboratory?

- A prescription from a physician.
- An active diagnosis.
- A statement of clinical concern or question.
- Recent clinic notes are very helpful. (Please fax to 804-321-2728).



Which tests are available?

A comprehensive analysis is usually recommended for patients with gait disorders. This includes a PT exam, videotaping the test, collection of kinematic, kinetic, and EMG data. Specific clinical questions may, however, lend themselves to a limited analysis, such as foot kinematics only. The components of a limited analysis can be determined on an individual basis.

Additional tests available on request

include:

- **Upper extremity analysis**
- Analysis of other functional body movements (e.g. sit to stand)
- Data collection for research studies



Does insurance cover gait analysis?

In most cases insurance does cover the cost or a percentage of the cost of an analysis. Prior to testing, a representative from Children’s Hospital Information and Referral Service Department checks the patient’s coverage and obtains pre-authorization if necessary.

Is gait analysis restricted to children and adolescents?

Absolutely not! We will test anyone with a movement disorder (preferably over the age of 2) who may benefit from gait analysis.

How do I get more information?

Call us at the Motion Analysis Laboratory and we will be happy to answer your questions. Our direct phone number to the lab is (804) 228-5824. The main hospital number is (804) 321-7474 and our toll free number for Virginia is (800) 443-0893. Just ask for the Motion Analysis Lab or extension 6557.

Or visit our Web site at www.childrenshosp-richmond.org/gaitlab

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