



## Stance-Control KAFOs – a new era in mobility

In the 1950s the polio epidemic swept across North America, rendering thousands of children paralyzed and lucky to be alive. Aimed at preventing collapse of the lower limb, an abundance of long-leg conventional braces enabled many to ambulate and lead a relatively normal life. A “stiff-leg” type of gait was the by-product of such a brace, and the technology involved with preventing knee buckling did not evolve significantly until about a decade ago. Enter the stance-control Knee-Ankle-Foot Orthosis (KAFO), and the liberation of many who thought they’d never walk normally again.

Traditional KAFOs are used in many applications to stabilize the knee and ankle combined. Those in need of such a brace have a functional weakness of the quadriceps and cannot resist the knee torque imposed by gravitational forces. Falling becomes inevitable. This clinical presentation is not limited to Poliomyelitis as described above. Any disease or injury that causes weakness in the quadriceps will demand the attention of a certified orthotist to assess, fabricate and fit a custom KAFO. The result to the patient is a lower risk of falling and significant improvements in confidence.

Dynamically, however, patients wearing a KAFO require more than normal effort to ambulate because the knee must be kept in a straight, locked position. Center of gravity pathways deviate vertically and the patient will walk with a noticeable rise as he or she moves over the braced limb on the ground. In swing phase, the limb must circumduct, or hip hike, to achieve clearance. Functionally, the limb is longer than the other because normal flexion angles at the knee and ankle cannot be obtained while wearing the brace. In short, safe ambulation comes at a visual and energy-consuming cost. In fact, Waters et al. showed in 1982 that the oxygen cost of walking with an immobilized knee increases as much as 23 to 33 per cent.

The longstanding problem for engineers has been to design a brace that allowed normal knee flexion in swing (unlocked), yet prevent knee flexion in stance phase for stability and safety (locked). Stance-control KAFOs solved that problem and revolutionized the concept of mobility for many patients with lower extremity paralysis.

The stance-control KAFO is an ingenious invention that utilizes inputs from the external environment to determine whether or not the mechanical knee hinge should be locked. There are several devices on the market, each with its own way of locking and unlocking the knee. The key feature of each is that the brace “knows” to lock the knee during stance phase and to unlock it during swing phase. A locked knee during stance means that flexion moments at the knee are resisted and the risk of falling due to quadriceps weakness is mitigated. An unlocked knee during

swing phase means normal knee and hip flexion angles can be achieved and taxing compensations such as hip hiking, vaulting and circumduction are eliminated. The result is a functional brace that offers the wearer a gait that’s much smoother in appearance. Beyond the visual benefits, the certified orthotist is also keen to observe, optimize and measure improvements in various gait characteristics.

Recent studies have shown that traditional KAFO users who were given *stance-control* KAFOs for a six-month period showed significant improvements over many metrics. For example, Irby, Berhardt & Kaufman showed significant increases in walking velocity, cadence, and stride length. There are indications, however, that experienced KAFO users may need more time to “unlearn” their ingrained inefficient gait patterns.



Stance-control technology has improved the quality of life for many patients with lower extremity paralysis. Today’s orthotists enjoy the additional tools to treat gait deficiency with more than the previous “locked knee” option.

The future looks promising in the field of orthotics as technology continues to advance toward a new era of mobility.