



**Octane**<sup>™</sup>  
FITNESS

## Body-Mapping Ergonomics<sup>™</sup>

### The Science Behind an Ideal Elliptical Cross Trainer

#### **Proper ergonomics transform workouts**

When it comes to elliptical cross trainers, the newest and fastest growing category of fitness equipment, all definitely are NOT created equal. Anyone can step onto several different machines and quickly realize that each has its own very distinct motion and feel—unlike other fitness equipment such as treadmills and stationary bikes.

An elliptical cross trainer is a unique combination of a stairclimber and a cross-country ski machine—requiring the feet to follow an egg-shaped, or elliptical, motion that typically goes forward or reverse. Some units also include arms that engage the upper body as well. The advantage of these total-body machines is that they require an upright, weight-bearing position in a natural, closed kinetic chain while training the all the body's major muscle groups—including the gluteals, hamstrings, quadriceps, calves, lats, chest, deltoids, biceps and triceps—which, taken together, results in maximum calorie burn and distinguishes ellipticals from virtually all other cardiovascular equipment.

Quality elliptical machines foster a smooth, natural, low-impact cardiovascular workout that challenges everyone from beginners to elite athletes. Studies have shown that compared to other exercises, total-body elliptical cross trainers require significant oxygen consumption and result in high caloric expenditure for efficient, effective workouts. Also, total-body machines that disperse the exercise throughout enable exercisers to work at higher intensities without actually perceiving greater exertion.

It is easy to see why these machines are tremendously popular, but before investing in an elliptical cross trainer, it is critical to evaluate its overall feel.

#### **The importance of biomechanics**

Biomechanics, which is the study of human movement, is an important consideration for any piece of fitness equipment, but even more so with the elliptical cross trainer due to the complexity and variance of its movement. For the optimum workout, the machine must fit the exerciser; individuals should never be required to adapt their posture, position or movement pattern to fit a piece of equipment. Elliptical cross trainers ideally should simulate how the body naturally moves for people of various shapes and sizes.

The motion on an elliptical cross trainer should replicate movements like walking or running, which involve similar biomechanics. Engineers therefore must consider numerous factors to make the exercise biomechanically correct while eliminating unnatural alignment or excessive, repetitive stress or torque.

On most elliptical cross trainers, the biomechanical analysis is as follows: the body moves in a linear direction through flexion and extension at numerous joints in the sagittal plane, including the shoulder, elbow, hip, knee, and ankle. Machines with arms may also include a minimal amount of radial and ulnar deviation in the frontal plane at the wrist joint. And in total-body units, the erector spinae may engage in a bit of rotation in the transverse plane throughout the range of motion.

#### **Critical ergonomic factors**

While biomechanics are integral in developing elliptical cross trainers, ergonomics is really where the rubber hits the road. Ergonomics is the science of adapting external conditions to suit individuals—or, in this case, using biomechanical analysis to build the best feeling elliptical cross trainers to satisfy exercisers and deliver results.

Octane Fitness—a group of dedicated exercisers with decades of experience in the fitness equipment industry—has developed its exclusive Body-Mapping Ergonomics<sup>™</sup> to create the most comfortable and effective movement on an elliptical cross trainer. Body-Mapping Ergonomics<sup>™</sup> consists of sophisticated motion analysis software, solid modeling, comprehensive testing, video analysis and human interface studies with input from biomechanists, medical professionals, personal trainers and exercisers. The end result is the patented QuadLink<sup>™</sup> Drive, which confers valuable advantages unique to Octane's equipment.

The essential ergonomic factors for elliptical cross trainers all contribute to its motion or feel—and exercisers should evaluate the following when choosing equipment:

**Stride length** – Either extreme—long or short—can cause hyperextension in the hip joint in the forward motion as well as unnatural, forced hip flexion when going in reverse, and both can cause discomfort. Octane Fitness has studied anthropometric data and solicited



feedback from exercisers of various fitness levels and different heights and limb lengths to develop an optimal stride of 19.5" that comfortably accommodates the majority of individuals in both forward and reverse motion.

**Stride angle/height** – This refers to the shape of the actual ellipse—whether it is more circular or oblong. With its patented QuadLink™ Drive, Octane Fitness has precisely perfected the stride angle so it doesn't feel too vertical like a stairclimber or cycle or too flat like a cross-country skier. The result is a natural, comfortable ride that optimally engages all major lower body muscles.

**Stride width/pedal spacing** – Research shows that the wider the space between the pedals, the greater the hips shift laterally during the movement, which can create lower back pain. In addition, a wide stance feels distinctly unnatural, since people walk and run with the feet and legs close together. Octane Fitness has the closest pedal spacing in the industry at 2 inches—which virtually eliminates erector spinae rotation and potential back stress.

**Pedal acceleration** – Anyone who has tried several brands of ellipticals immediately notices the difference in how quickly and smoothly the pedals move. Some are faster on the downstroke and drag on the upswing; others have a "kick" on the upswing that unnaturally propels the pedals and can throw exercisers off balance. Without steady pedal acceleration, the result is a herky-jerky, uncomfortable and potentially unsafe movement. Again, Octane's precision affords exercisers with fluid, stable motion and consistent muscle and joint recruitment, stroke after stroke.

**Inertia** – Inertia deals with the amount of effort it requires to get the pedals moving. With too much inertia, it is difficult to get the machine going, but once started, momentum kicks in and relieves exercisers of significant effort—essentially bringing them along for the ride. Utilizing computer software and exerciser feedback, Octane Fitness elliptical cross trainers have the optimum amount of inertia for steady, consistently demanding workouts.

**Pedal articulation** – In most elliptical machines, the ankle joint engages in dorsi flexion on the downstroke and plantar flexion on the upstroke. Octane studies show that excessive plantar flexion leads to transient paresthesia, a "numb toe" condition due to compression of nerves in the foot, and extreme dorsi flexion can limit knee and hip extension, which are essential for a complete range of motion. Video analysis and computer software enabled Octane Fitness to create pedals that support the ankles and feet naturally throughout the entire stride.

**Upper body pivot point and range of motion** – Unlike treadmills, stationary cycles and stairclimbers, many elliptical cross trainers engage the upper body in movements that should be synchronized with leg motion. Here, research has intuitively shown that arm handles should simulate natural shoulder and arm flexion and extension as seen in walking or running, and that excessive radial or ulnar deviation may cause wrist discomfort. Unlike many ellipticals, Octane Fitness' patented design facilitates a unique, low pivot point for arm movement to create a more comfortable axis of rotation, minimize radial and ulnar deviation and provide an appropriate range of motion throughout the arm swing. The shape of and multi-positioning options on Octane's arm handles also encourage proper posture while stimulating the core musculature (abdominals and back) for stability.

Also, Octane provides stationary bullhorn handlebars for safety when mounting or dismounting, for use during cooldowns or for exercisers who want to focus temporarily only on lower body exercise.

### Exceptional exercise experience

Precise biomechanical analysis and exacting ergonomics are critical to elliptical exercise effectiveness, motivation and adherence. The passionate exercisers at Octane Fitness focus all their resources exclusively on ellipticals to deliver the most biomechanically correct, ergonomically comfortable and enjoyable exercise experiences that foster optimal results.

### REFERENCES

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Van Gelder, Naneene and Sheryl Marks (Eds.), Aerobic Dance-Exercise Instructor Manual. American Council on Exercise, San Diego, CA, 1987.

*For more information, contact Octane Fitness at [www.octanefitness.com](http://www.octanefitness.com) or 763-757-2662*

