KICKBIKE – Your key to optimum sports performance

Efficient Running is essential to optimum performance of most sports we play. Whether we want to maximize our speed, maximize our endurance, or both, an efficient stride is critical.

For endurance events, some people still believe that the "shuffle" – with the feet hardly clearing the ground in the recovery phase of the stride – is the most efficient. In recent times, however, scientific studies seem to indicate that this is only the case at extremely slow speeds – way below the speeds of running required for competition – even the marathon!

One of the most interesting topics of scientific study in recent years has been that of the relationship between **foot-contact time** and performance. Minimizing foot-contact time has for many years been recognized as a key to improving sprinting speed

So how do we minimize our foot-contact time?
To understand the "Optimum Stride", we must understand the three principles on which the whole theory is based.

1. At a constant speed, the force (or push) is applied **vertically.**
2. This force must be maximized – our **anti-gravity** muscles must work hard each time we touch the ground so that our support structures are stiff, and we can "bounce" back off the ground.
3. By each muscle group reaching **full stretch** at some time in each stride, we fully utilize our body's own natural "**springs**" – our tendons and "fascia". (Fascia is white elastic connective tissue that forms an intricate web that protects and enhances our musculo-skeletal structure). The more energy returned to our stride though these natural springs – the **less total energy** that is required from our muscles.

The great training opportunity that KICKBIKE offers:

- Using a kickbike as part of your training routine (or for your daily transport!) allows us to practice the **correct stride geometry** at a much slower pace than running demands. The fact that with running we "fall back to the ground" means that training ourselves to execute the correct stride pattern is near impossible because of the speed at which we must move our legs.
- Kickbiking is a **weightbearing** activity. Even our support leg is performing an invaluable **anti-gravity** excercise

Choose which article most suits your interest:

- **Optimum Stride: the Basics, or**
- **The Science Behind the "Optimum Stride"**

Optimum Stride: the Basics

* The major difference between stride geometries in running and on the Kickbike is that with the Kickbike, the angle of our body, with respect to vertical, changes.

**At all times in our stride we try to keep our waistline horizontal. Therefore, on the kickbike, our support leg bends and extends – raising and lowering the height of our body as we lift and strike down with the drive leg.

1		We start with the driving leg in its highest position, and our toes pulled up. We feel a stretch in our backside and at the back of our legs. We fire the muscles in our backside and also begin to straighten our leg. We should feel that we are ‘squeezing’ our backside.
2		We continue to use our backside to strike down with the drive leg, which is now almost straight. We now begin to release our foot from the “toes up’ position and prepare to ‘actively” strike the ground.
3		Foot-ground contact occurs with the leg quite stiff and actively trying to straighten – as if we were jumping – through the hip, the knee, and the ankle.

4		As our leg straightens, our calf muscles tighten. We continue to try to fully straighten our leg so that as we break contact with the ground, our toes are pointed.
5		Immediately after toe-off, we feel should feel a stretch at the front of our hips, and at the front of our shins. We should now begin to fire these muscles that are feeling a stretch. This means we should immediately try to bring the toes up and the knee forward. If we can possibly co-ordinate it – we try to keep our calf muscle activated.
6		We continue to try to move our knee forward. We keep our toes up and try to keep our calf muscle activated. The “whip mechanism assists our muscles to raise the lower leg. Our foot now tucks neatly under our backside, We keep accelerating our knee forward.
7		We keep propelling our knee back up to our starting position (so we feel a stretch in our backside). We can relax our calves now and let our leg begin to unwind. We still want our toe to be in the “pulled up” position.

** Remember to change drive leg after about 5 strides on the kickbike.

Our final advice is this:

- Be Patient
- Enjoy

Each day, learn that little bit more of what if feels like when **your body** works as it is supposed to!

The Science Behind the "Optimum Stride"

Recent studies have also related low foot-contact time to better running economy (a lower volume of oxygen consumed per kg body weight at a given speed) and VO2 max (maximum volume of oxygen uptake per kg body weight for an individual athlete). In fact, established that Heart Rate divided by VO2 max was a statistically significant predictor of VO2max – and possibly the best and easiest method of predicting this measure without actually directly collecting an athlete's breath while running – a difficult task!

The "optimum" stride kinematics - one stride cycle broken into eight stages for descriptive purposes are detailed following.

* The major difference between stride geometries in running and on the Kickbike is that with the Kickbike, the angle of our body, with respect to vertical, changes.

**At all times in our stride try to keep our waistline horizontal. Therefore, on the kickbike, our support leg performs an action similar to a single leg box squat – extending and flexing through the knee and hip.

1		We start with the driving leg in its highest position, and our toes pulled up. Glute Max and Hamstrings have reached full stretch and begin to fire. "Force closure" of the pelvis (with transversus abdominis and multifidus) tightens fascia and enhances this effect. The ITB, tensioned through gluteus maximus, and patellar femoral tendon, tensioned by the quadriceps muscles (except rectus femoris) will continue to extend the knee.

2		Gluteus maximus has continued to power hip extension, and together with the quadriceps muscles mentioned above has extended the knee joint and continued to stretch the hamstrings (maintained the tension). The hamstrings, being active, have also helped power hip extension. Interestingly the hip has not accelerated greatly as yet, due to the extra rotational inertia of the extending leg. However, with hip extension forces now high, acceleration is dramatically increasing. Tibialus anterior relaxes and the calf muscles begin to fire.
3		Foot-ground contact occurs with the leg structures very stiff as impact energy is absorbed in the tendons of the foot, the Achilles tendon, and the ITB. From the last position, the knee has flexed again somewhat as the hamstrings have contracted. The hip extension has accelerated, enabling the foot to more closely match the ground speed relative to the body. The calf muscles continues to work towards plantarflexion of the foot. The quadriceps (except rectus femoris) and gluteus maximus (through the ITB) again begin to extend the knee. The hamstrings and glute max serve to continue accelerating the leg and foot so as to match the ground speed relative to the body. All of the above elements minimize the horizontal forces applied to the ground and maximize the vertical forces applied.
4		As the knee extends to straight, the gastroc is tightened and fires. The toes are now being compressed into dorsiflexion as the rest of the foot plantarflexes, reinforcing the windlass mechanism, and returning stored energy. The plantarflexing muscles of the toes have begun to fire.
5		Immediately after toe-off, the hip flexors are at full range, and elastic energy storage in the ITB (through the TFL) causes initial movements of hip flexion. As with the first frame of the stride, the fascial planes are again "wound-up", and their recoil assists hip flexion. Also, TFL itself begins to fire. Tibialus anterior has also reached full stretch and also begins to fire.

6		Relaxation of quadriceps muscles allow the whip mechanism to begin to bend the knee and raise the lower leg. Tibialus anterior continues to dorsiflex the foot. The gastroc remains active. The flexion of the knee causes the ITB to be placed under further strain causing hip flexion to accelerate. We keep propelling our knee back up to our starting position (so we feel a stretch in our backside). We can relax our calves now and let our leg begin to unwind. We still want our toe to be in the “pulled up” position.
7		Because the ankle has been dorsiflexed, and gastrocs have continued to fire, the lower leg has been fully recovered to the maximum flexion of the knee by the two-joint nature of the gastrocs assisting and completing the action of the whip mechanism (the short head of the biceps femoris may also assist). As the knee flexion has increased, the ITB has continued to be tensioned (lengthened), allowing the TFL to accelerate hip flexion while minimizing change in its contractile element fibre length. Also, as knee flexion has neared its maximum, the patellar-femoral tendon has been stretched. This has aided hip flexion and caused the rectus femoris to fire. Movement has continued as before with rectus femurus accelerating hip flexion. At this point the gastrocs and the toe plantar flexors relax. Tibialus anterior remains active. Because gastrocs are relaxing, the lower leg will begin to unwind (the knee will extend).

The following are hypotheses or inferences taken from the kinematics.

- Muscles are stretched to full range before contraction takes place – possibly utilizing the stretch reflex and reciprocal inhibition.
- The two-joint nature of the gastroc, hamstring, glute. max, TFL, and toe dorsi-flexors are fully utilized – particularly in respect to joint geometries.
- Achilles Tendon, Patellar Femural Tendon, Ilio Tibial Band, and Tendons of the Foot are kept in tension – reducing the phase lag when muscles attached to them are activated.
- Taking Muscles to full stretch allows time for the phase lag of the rise of the contractile element force and delivers a much smoother total muscle-tendon-unit force.   Series Elastic Elements and Parallel Elastic Elements are utilized to their full potential.
- The stiffness of support structures is maximized while full natural flexibility is maintained.