POSTURE AND MUSCULAR IMBALANCES:

Pilates as a complementary practice for cycling

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Abstract

Cycling and mountain bike riding are excellent sports to improve cardiovascular endurance, lose weight and strengthen legs muscles, especially when other cardio based activities are not recommended in presence of bad injuries. The consistent practice of cycling, especially by amateurs, might cause or aggravate existing postural deviations and muscular imbalances. When we combine these postural deviations and muscular imbalances with others factors, every day habits, stress and age, in a very long time, low back pain or neck pain or pain in the joints pain might occur.

I introduce this paperwork with the definitions of posture, the most common postural deviations, the posture and the anatomy of the cyclist and the muscular imbalances that you can often observe in the body of a cyclist: some muscles group tend to be overused and others tend to shorten. To finish with the examination of a case of a road cyclist and mountain bike rider, who has chosen to add a Pilates program, based on BASI repertoire, to improve his performance and his posture on the bike.
1. Ideal posture and common postural deviation

2. Posture, anatomy and muscular imbalances in the gesture of the cyclist

3. Pilates as a complementary work out for cycling: a case study

4. Conclusions

5. Biography
1. Posture: a definition

What do we intend for posture and ideal posture?

There are quite a number of definitions of posture, let’s see some of the most used in anatomy.

“The position of the body or body parts in the space, determined by group muscles activities” (cit. Garzanti)

“The posture is the position of the human body in the space and the relationship between its limbs. It might be standing, or seating, prone, supine or on the side. It’s the most suitable position for the body to stay balanced against gravity with the less energy expenditure possible and the best comfort. (cit. Wikipedia).

“The posture is defined as the orientation of the body parts in space and time”.

So, we need to consider different aspects, like the body mass distribution, the force exercised to keep that posture, for how long, and the effects on the human body to keep that position.

Considering all these factors, we can agree that the posture is not a static concept and we cannot separate it from space and time, because it changes with age, habits, stress, external factors, environment, weather etc.

We will have always a posture, even if we don’t pay attention too much about it, it will be a permanent feature.
Ideal posture and postural deviations

The maintenance of the posture is practiced by tonic muscles, with a reflection mechanism controlled by receptors inside the muscles, or motor neuron.

The anatomical position is a posture characterized by the vertical alignment of the upper body and the lower body standing on both feet. Considering that each mass is composed by particles attracted to the body by gravity, the force used is against gravity is our body weight; it is possible then that with an established point in which one force is applied that is equal to the body weight and it acts vertically upwards, we can find balance in every position.

This point is called center of gravity (CG) and it’s the point in which all body weight is concentrate.

Around the gravity line, the body is hypothetically in a balanced position that might imply a uniform distribution of the weight and a stable position for each joints.

An ideal posture is given by a good muscular and skeletal balance that will protect the skeleton from lesions.

In this scenario the muscular system works efficiently, the internal organs and the abdominals are in optimal position, versus a scenario with an improper posture where the relationship between body parts are modified producing an increase of tension.

We can observe the posture of a person and possible deviations from 3 different points of view or
planes: antero/posterior or sagittal plane, frontal or coronal plane, transversal or horizontal plane.

When viewing the human body from the side (in the anatomical position) we can observe the alignment of it with respect of some points that should form a plumb line when ideal alignment is present. (the 90% of the population doesn’t have the ideal alignment). Following the points:
lobe of ear, mid line of the cervical vertebra, shoulder joint, midway through trunk, greater trochanter of femur, slightly anterior to the midline of the knee, slightly anterior to the lateral malleolus.

When viewing from the front/back view, we can observe if asymmetries are present and some bony landmarks can include the head, shoulders, space between the arms and the trunk, the pelvis, the knees and feet.
When viewing from the horizontal plane a normal person with an ideal posture shouldn’t have any moving forward or back of shoulders or gluteos (between right and left) and none rotation of scapulae or pelvis.

The most 4 common postural deviations are the hyper lordosis, kyphosis, flat back and sway back. In all these deviations there’s a misalignment of the pelvis from the neutral position in which ASIS and PS are in the same horizontal plane; in hyperlordosis the ASIS is in front of the PS, so it means that we have an anterior tilt of the pelvis, in flat back and sway back postures, the PS is in front of the ASIS that correspond to a posterior tilt of the pelvis.

Figure 4: Ideal posture from the horizontal plane

Figure 5: Ideal posture and common postural deviations
It is possible that one or more postural deviations are present in the same subject; it is important to understand if the deviation is structural or functional (developed after incorrect postural habits) or a combination of both. A deviation might start as structural and evolve as functional with the consequence that the muscular system adapts to the deviation starting to compensate and producing muscular imbalances.

Is it important to identify these characteristics not only for the athletic activity but also to pursue regular day life activities with the passing of the time.

2. Posture, anatomy and muscular imbalances in cycling

The bike industry is in constant technical evolution of the bike with new materials (aluminium and carbonium), new frames, saddlers and pedals that are allowing the cyclist to improve performance, protecting the body and joints from extreme stress.

Apart from the technological progress, it is important to consider the potential postural deviations, feet asymmetries, spine and hip anomalies and besides the perfect asset of the bike, it is important a correct functionality of the body.

Following some factors that might affect the cyclist’s performance: postural deviations of the cyclist when in anatomical position, bike set up and posture on the bike (this last might affect 50% of the performance).

The first factor affects the last one, if the person doesn’t have a proper posture in general, the body must compensate, provoking more energy expenditure and in the long period this might evolve in pathologies.
The athlete gesture of the cyclist is characterized by 2 kind of muscle contractions: isotonic and isometric.

The isotonic contraction implies muscles to reduce during the movement: the lower limbs are involve in a cyclic action or pedaling.

The isometric contractions are characterized of the contraction of the muscle, no change in the length of the muscle: the muscles of upper body are used to stabilize.

The body will fatigue faster in the lower body, instead the upper body which is connected with the bike through 5 footholds (hands-bar, feet-pedals, hips-saddle), realizes isometric contractions in the name of a constant balance.

In general the cycling position is not natural, in terms of the three natural curves of an “S” of the spine; in fact the spine loses its shape as the body rounds forward from the tailbone to the shoulders when reaching between the saddle and the handlebars.

The pelvis deviates from the neutral position.

So as the head and shoulders come forward, with a strong pressure on the cervical vertebrae, legs and feet do the same movement with the same ROM for many hours, and the hip flexors and quadriceps are under strong stimulation to sustain the rhythm.

A correct posture on the bike will save energy during isotonic muscle contractions, improving the optimization between force and endurance in the pedaling.

An incorrect posture, for example if the pelvis tilt too far forward, might activate pathologies and excessive stress in the muscular fasciae involved in the isometric contractions, pulling the lumbar vertebrae out of the alignment, causing pain and leading to lower back disorders. In a situation of abnormality, the agonist muscle contracts, the antagonist relaxes, suspending the normal co-contraction dynamic. In case of damage, a muscle will always be contracted or relaxed, as a defense, until
something will happen to bring the muscle to work as usual.

We can see in the figure n.6 an example of good posture on the bike and a bad one for the pelvis.

The image on the right (bad) is how most people sit on a bike seat. Sitting in this position compresses your stomach, your hip flexors and can put undue strain on your lower back. The image on the left shows the better way of sitting on a bike. When sitting the right way, the pelvis is tilted forward and the cervical vertebrae are in line with the rest of your back. When sitting in the wrong position, the pelvis is upright and the mid and upper back bend all the way forward. To sit in the right position requires strength in the lower back.

It is obvious that a professional cyclist take seriously a harmonious training, creating a balance musculature. The amateur maybe won’t feel any discomfort in young age, but with time, if he/she only rides, might starting to feel pain once in a while or postural deviations that are already present in the body might get worse.

In general we can say that in the short term neck and back muscles might stress resulting in tension headaches and neck pain. In the long term the effect is a permanent curvature of the neck that bring to misalignment in the thoracic spine (kyphosis), calcium deposits and skeleton structural changes in the cervical vertebrae.

The kyphosis might turn in chronic upper back pain, decrease of the lung function and a permanent curvature to the upper back.

Figure 6: Good and bad posture in the bike A= pelvis B= center of gravity
Anatomy of the cyclist

Figure 7: Prime muscles involved in cycling
Figure 8: Leg and hip muscles

Figure 9: Hip flexors on the left, hip extensors on the right
Legs and gluteus work as driving force, the trunk as stabilizer and arms and shoulders are contract to keep the posture.
Figure 12: Shoulder and elbow prime muscles

(a) Pectoralis major and latissimus dorsi (left anterior lateral view)

(b) Left deltoid and left latissimus dorsi (posterior view)

(c) Deep muscles of the left shoulder (anterior lateral view)

(d) Deep muscles of the left shoulder (posterior view)
Figure 13: Abdomen muscles

(a) Superficial and deep abdominal muscles (anterior lateral view)

(b) Posterior abdominal muscles (anterior view)
Table 1: Primary muscles involved in cycling. In yellow muscles that act as movers, in green muscles that work as stabilizers

<table>
<thead>
<tr>
<th>Major joint</th>
<th>Prime mover/muscle</th>
</tr>
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<tbody>
<tr>
<td>LEGS/FEET</td>
<td></td>
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<tr>
<td>HIP</td>
<td>iliopsoas, rectus femoris, sartorius, gluteus maximus</td>
</tr>
<tr>
<td>KNEE</td>
<td>biceps femoris, quadriceps femoris</td>
</tr>
<tr>
<td>ANKLE-FOOT</td>
<td>peroneus, tibialis anterior, gastrocnemius, tibialis posterior</td>
</tr>
<tr>
<td>HEAD, NECK</td>
<td></td>
</tr>
<tr>
<td>SPINE</td>
<td>Sternocleidomastoid (SCM), scalenus, trapezius, longus colli</td>
</tr>
<tr>
<td>ARMS</td>
<td></td>
</tr>
<tr>
<td>SHOULDER</td>
<td>Pectoralis major, latissimus dorsi, middle deltoid</td>
</tr>
<tr>
<td>ELBOW</td>
<td>biceps brachii, brachialis, triceps brachii</td>
</tr>
<tr>
<td>TRUNK</td>
<td></td>
</tr>
<tr>
<td>SPINE</td>
<td>Rectus abdominis, external oblique, internal oblique, erector spinae, quadratus lumborum</td>
</tr>
</tbody>
</table>

PS: In mountain bike riding the muscles are used a little bit differently in terms of pressure and stimulation in the joints. It requires even more work for the muscles of arms and shoulders and abdominal oblique to turn the bike and jump and absorb trail vibrations. In triathlon bike the upper body is pulled even more forward.
Pilates as a complementary work out for cyclists: a case study

Client: Adam, 30 years old, height 6’3”

General condition: healthy and fit, right handed

Job: Sales manager in the bike industry

Previous injuries: Tibula, Fibula and Patella of the left side broken from a car hitting while he was riding – he still have the metal in the knee and leg. L2, L2 and L4 compressed during skiing.

Actual work out routine: Adam rides his bike 3-4 times a week, around 150 miles a week with both road and mountain bike. He does push ups and sit ups 3 times a week.

Past Pilates experience: 20 sessions during physical therapy after the leg and knee surgery.

Why Pilates: after finishing the physical therapy he quit doing Pilates for almost 2 years. He feels that Pilates can help him to improve the performance. Sometimes he feels pain in the injured leg, especially the day after he rides.

First session

Due to his injuries and habits these are some considerations.

Roll-down: difficulties to articulate cervical vertebrae as well as lumbar vertebrae, roll down with a flat back on the lumbar region and legs hyperextended. Postural deviations from the side: slight kyphosis, head pulled forward and tilt of the head to the left, internal rotation of the shoulders. From the front/back, the left injured knee/leg slightly external rotated. Adam is very tall and obviously to look at the other people he pulls his head forward involuntarily. His normal and relaxed posture is with crossed arms, tilt of the head to one side, and tilt of the hip on one side, slightly rotation of the trunk.

He sits most of the time for work and when he rides the bike.

During the fundamental warm up, there are difficulties to isolate the pelvis and keep it neutral, he’d
rather tuck the pelvis in the abdominals exercises.

For the very first session he practiced fundamental foot work, hip work, abdominals, arms and stretches on the Reformer, following the BASI Repertoire, avoiding spinal articulation exercises, besides the pelvic curl.

He performed side overs prep on the ladder barrel and fundamental back extension on the mat.

This session was important to understand the alignment of the body in static position and in movement, strengths and weaknesses.

It was clear also in the anatomical position before the roll-down that the upper body is not as strong as the lower body. Foot work and hip work on the Reformer were very good considering the misalignment of one leg, good range of motion, reasonable control and resistance. Hip flexors and hamstrings flexibility during the standing lunge stretch are quite good. Very weak abdominals, especially the oblique with the head that wants to take over and the trunk rotates. Arms and back muscles to strengthen and lengthen, especially pectoralis, latissimus dorsi and serratus.

General awareness of the body: fair

**Goals in the short period:**

- strengthen the transverse abdominus (TA) and internal and external oblique (so that when he rides he doesn’t put all the energy on the legs considering the past injury and to reduce the stimulation on the hip/knee/ankle joints).
- stretch and strengthen pectoralis major, latissimus dorsi, rhomboids and lower trapezius (so he can relax neck muscles, starting to recruit correct muscles)
- establish a breathing during the session
- neutralize pelvis during abdominals exercises
Goals in the long period:

- increase range of motion and strength in the back
- increase range of motion and strength in lateral flexion/rotation exercises
- improve coordination between upper and lower limbs
- increase general awareness of the body

<table>
<thead>
<tr>
<th>BASI Block system</th>
<th>SESSION 1-10</th>
<th>SESSION 10-20</th>
<th>SESSION 20+</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARM UP</td>
<td>Fundamental w/up</td>
<td>Intermediate w/up</td>
<td>Intermediate w/up</td>
</tr>
<tr>
<td>FOOT WORK</td>
<td>Reformer (first 5 sessions) or Cadillac: foot work</td>
<td>Reformer or Cadillac or Wunda Chair(after 15): foot work</td>
<td>Reformer or Cadillac or Wunda Chair(after 15): foot work</td>
</tr>
<tr>
<td>ABDOMINAL</td>
<td>Reformer: hundred prep, hundred. Step barrel: chest lift, reach, overhead stretch</td>
<td>Reformer: hundred, coordination, abdominal double legs and double legs with rotation in straps Cadillac: mini roll-up, mini roll-up oblique, roll up with PTbar top loaded Wunda chair: standing pike and reverse standing pike</td>
<td>Avalon: mini roll-up, mini roll-up oblique, Roll-up, roll-up with extension, leg changes, hundred</td>
</tr>
<tr>
<td>HIP WORK</td>
<td>Reformer or Cadillac: fund. hip work series</td>
<td>Cadillac: basic single leg supine series (+ see session 1-10)</td>
<td>Avalon: hip work series (+ see session 1-20)</td>
</tr>
<tr>
<td>STRETCHES</td>
<td>Reformer: standing lunge or Ladder Barrel: fund. stretches (gluteals, hamstrings, adductors, hip flexors) and Step Barrel: shoulder stretch lying side or Pole stretches series</td>
<td>Reformer: standing or Kneeling lunge Ladder barrel: shoulder stretch 1 and 2 Step barrel: stretch of hamstrings and hip flexors</td>
<td>See session 1-20</td>
</tr>
<tr>
<td>SPINAL ARTICULATION</td>
<td>/</td>
<td>Reformer: bottom lift, bottom lift with extension</td>
<td>Cadillac: bottom lift with RUBar or Avalon: bottom lift, semi circle</td>
</tr>
<tr>
<td>BASI Block system</td>
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<tr>
<td>FULL BODY</td>
<td>/</td>
<td>Reformer: scooter (from 10 to13), Up Stretch 1 or</td>
<td>Cadillac: sitting forward</td>
</tr>
<tr>
<td>INTEGRATION f/i</td>
<td></td>
<td></td>
<td>Reformer: Up Stretch 2</td>
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<td></td>
<td></td>
<td></td>
<td>Cadillac: breathing through with PTBar</td>
</tr>
<tr>
<td>ARMS</td>
<td>Reformer: arms supine series or Ped a pole fund. arms series or</td>
<td>Avalon/chair: arms sitting series or Cadillac: standing arms series (+ session 1-10)</td>
<td>See session 1-20</td>
</tr>
<tr>
<td>FULL BODY</td>
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<tr>
<td>INTEGRATION A/M</td>
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<tr>
<td>LEG WORK</td>
<td>/</td>
<td>Reformer: single leg skate</td>
<td>Cadillac: squats</td>
</tr>
<tr>
<td>LATERAL FLEXION/ROTATION</td>
<td>Mat: side lift or Step Barrel: side lift with theraband or Ladder Barrel (after 6): side overs prep</td>
<td>Wunda Chair: side stretch</td>
<td>Reformer: side overs on the short box</td>
</tr>
<tr>
<td>BACK EXTENSION</td>
<td>Reformer: breaststroke prep, pulling strap 1 or Step Barrel: swan prep or Ladder Barrel: swan prep</td>
<td>Reformer: Pulling strap 2 (after 13) Wunda chair: swan basic Cadillac: prone 1</td>
<td>Wunda chair: back extension single arm Reformer: breaststroke</td>
</tr>
</tbody>
</table>
4.

Conclusions

After 10 sessions: Adam is amazed about how he feels stronger on the abdominals and the benefits when he rides are tremendous, especially with the mountain bike.

He continues to feel pain in the injured knee sometimes, but less often in comparison on when he wasn’t doing Pilates. During the last sessions, his tendency to tilt the head has decreased and also the tendency to cross the hand in the chest during the foot work on the Reformer.

The roll down is more fluid and natural; the head doesn’t take over anymore when performing the abdominal exercise, especially during lateral flexion/rotation, he’s definitely stronger and with more range of motion in rotation. The posture of the upper body has improved slightly as a result of the strengthening of the arms/shoulders muscles and abdominals.

The Pilates breathing is not yet quite very natural and there’s still a tendency of tucking the pelvis.

I hope that he’ll continue to do Pilates so he will be able to see and feel a really improvement on his posture and a body more balanced. It’s been difficult to have a consistent work out with him because he travels a lot and when he’s free, he prefers to ride.

But he has understood that Pilates might become a key complementary work out if he wants to ride and reduce/prevent pain that might appear with age.

The right thing is in the middle. Joseph Pilates himself is an advocate of the principle of balance, not only for the Contrology method but also to live a healthy and balanced life.

Pilates is the best practice to recruit precisely muscles, to improve strength and flexibility, with a special care of the alignment of the body. The BASI repertoire exercises are meant to develop deep abdominal muscles like the TA, which is critical to the achievement of a correct posture.
5. Biography for contents and pictures

“BASI Study Guide” and all the “Movement analysis workbook”
“Anatomy of movement” by Calais German

http://besport.org/sportmedicina/postura_ciclismo.htm
http://cirrie.buffalo.edu/encyclopedia/en/article/190/
http://scienzaesalute.blogosfere.it/post/526077/iperlordosi-lombare-i-sintomi-le-cause-e-le-cure
http://www.centroriabilitativoreggiano.it/?p=1193
http://www.benessere.com/fitness_e_sport/ginnastica/cond_muscolare.htm
http://www.bikeitalia.it/anatomia-ciclista-uso-dei-muscoli/
http://velosapiens.it/imuscolinelcicli.html
http://www.ap.pr.it/new/pdf/INTERVENTO%20CHIENSILOGICO%20MIRATO%20AL%20MIGLIORAMNETO%20DELLA%20POSTURA.pdf
https://jonathanblyer.wordpress.com/2011/05/05/cycling-posture/
http://www.aqspeed.com/member/run-faster/muscles-movements/hipextensors/
http://www.sbcoachescollege.com/articles/HamstringDominance.html
http://www.basipilates.com/community/blog/2013/10/the-head-and-neck/