Observational Effects of the Tad Coffin Performance Saddles SmartRide-Rx™ Saddle and a Hypothesis as to the Production of these Effects

Prepared by Melissa Holland, DVM, DACVA July, 2018
540-461-0260
saddlestudyquestions@gmail.com

Background From Tad Coffin Performance Saddles

"The latest version of our technology, SmartRide-Rx, can actually be therapeutic. When placed on a horse's back for 20 minutes with the girth on, the technology has consistently demonstrated an ability to significantly reduce or completely eradicate back pain and create a state of deep relaxation. While this may seem like magic, we believe this effect is due, in part, to an electromagnetic phenomenon in the tree that is a result of the combination of the materials we use, the manufacturing processes, and the geometric features of the tree itself."

The manufacturer/designer reports a number of short term and long term positive effects produced in the horse by the regular use of the saddles containing this technology. These include, but may not be limited to:

- Relief of muscular pain, most especially along the horse's back muscles - longissimus and the overlying and contiguous latissimus dorsi, figure 1. These muscles are highly integrated with the other major muscle groups of the topline and the hindquarter. Tension and toxin build-up in these two muscle groups can propagate to the other major muscle groups of the hindquarter and through the neck, creating stiffness, resistance, and lack of fluid, forward motion. These muscles also attach to the processes of the spinal vertebra. Muscle dysfunction or fatigue from misuse or overuse changes normal muscle length which may 'pull' the vertebrae 'out of alignment' and reduce range of motion. Massage and chiropractic adjustment may not produce expected results or results which do not last. Note, the saddle and the rider sit along the longissimus and the latissimus.

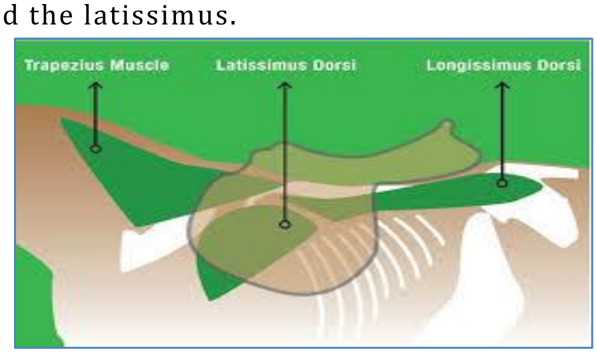

Figure 1

- Improvement in cardiovascular function and faster recovery from exercise.

- Improvement in immune system function, including reductions in allergic skin reactions and improvement in chronic allergic conditions
- Improvement in hoof condition
- Reduction in apprehension in general and during exercise/work, shoeing, veterinary care, etc.
- Reduction in over-reaction to adverse stimuli such as new things in the routine or environment or to new challenges in training or work, such as a new jump in the ring or something 'spooky' on the trail.
- Improved attention and focus during work and reduced resistance to learning during work

A User's Observations

After a year using the SmartRide technology in the form of the TC2 saddle, I have observed all of these effects. I have also observed reversions in some of these effects when the saddle is not functioning correctly.

Initially, I did some very basic research into changes in heart rate with the SmartRide saddle. Why? I noticed in the first few rides that the horse just didn't seem as hot, didn't sweat as much, and recovered more quickly post exercise. What could be easily measured with little equipment? Well, heart rate of course! If you can take a pulse, you could repeat my study. In brief, the saddle produced a 25 to 30% reduction in resting heart rate and a post-exercise heart rate recovery to this new resting rate in a shorter time than was seen with comparable saddles without the SmartRide technology (up to 50% faster recovery with the SmartRide saddle). The results of that study are available upon request. Please feel free to repeat it as well.

Faster recovery from exercise was not only measurable in heart rate recovery, but observable. In fact, this was the effect which started my 'research'. Exercise induced sweating was less when ambient temperature and humidity were lower than 75 degrees F and 60% respectively. Sweat dried more quickly. This resulted in reduced need to cool the horse with water hosing. For horses with poor hoof quality, applying less water to cool or remove sweat means less hoof wet/dry cycling , which is bad for hoof quality and water content.

I noticed right away, within a few rides, that the horse's attention to the work was improved. He was less distracted and less reactive, or over-reactive, to stimuli than when working in my other saddles. He paid attention. Is this a result of being more comfortable in this technology? I believe so. Remember those muscles of the topline. They are, with the spinal column in that region of the horse, literally the drive train. If those muscles are happy and functioning optimally with saddle and rider in place, the work of work should be easier and likely more efficient.

Consider the runner or the cyclist or the down-hill skier. The science that has gone into helping these human athletes to shape their stride and body movement to produce the most efficient movement is legion. The movement that covers the greatest distance with the least expenditure of energy and resistance is, by definition, the most efficient. We, the riders of the world, are way behind this technology curve. Why? Well, how do you teach a horse to be more efficient in his work? Ponder that. I think the best we can do is get out of his way as much as we can, while still giving direction, communicating what we want, and answering back when the horse responds. What if a saddle becomes something more than just a place to sit and drive the work? What if it becomes a tool that promotes efficiency of movement and that improves communication between horse and rider? Is this not, collectively, the definition of making the work of work more efficient? What stands in the way of making work more efficient? Resistance. I suspect that horses spend more energy than they should just to work around saddles that don't promote efficiency either because they are just not comfortable to wear, or they don't move with the horse and so impede efficient and forward motion. Maybe the observation of quicker recovery after exercise is partly explained by a horse that doesn't have to work as hard to answer the questions the rider is asking because he is not being impeded by a saddle that doesn't move with him.

Other Observations

Skin –

I have a moderately itchy thoroughbred in the summertime. All year long, he is prone to skin disease – scratches mostly caused by the skin-resident bacteria D*ermatophilus congolensis*. It is a constant battle. Scrub it with medicated shampoo? Dry it out with astringents? Wave a voodoo doll over it? Nothing slows it. Let it rain more than a sprinkle and hives is the answer next morning. Whip out the anti-histamine. Delay the steroid as long as you can. You know this horse. You may have one yourself. I have observed that this year has been different. There are the usual horse fly bites, but the 'creepy crawly' skin crud is pretty much gone. We pretty well understand that chronic inflammatory skin disease in horses has an immune system component. Some horses cope pretty well; some don't. Why? This bug is a resident skin bacterium. The horse's immune system ought to be able to keep it in its place.

I believe that the immune systems of all mammals are under assault all the time. Everything we eat and drink is grown in chemically treated and mineral-depleted soils. The rain that fills our aquafers, lakes, and streams is acidic and chemical-ridden. We are distracted and over-stimulated all day and half the night. We are functionally disconnected to the ground we tread. Except for maybe that last one, our horses are no different. Most don't get enough life with the herd. Most don't get enough turn-out, and they are lucky if there is a 'weed' in sight. Did you know that thistle is very high in calcium? Ever watch a horse graze? They eat dandelion if it's there. They eat thistle if it's there. Their water pretty much comes from the same sources as our water. They don't have the option of bottled water. They drink what we put in the bucket or the trough. It's no wonder the immune system is in overdrive. Much like people, the horse's immune 'flare' shows up in the skin, the respiratory tract and to a lesser extent, but no less important, the digestive tract. The skin is the thing we see every day. Does the itchy horse have an immune system that doesn't work as well or is it working in overdrive? Either way, it is not in balance and not working efficiently.

Is this improvement in immune function as evidenced by a middle aged horse that seems finally to be keeping the ubiquitous *dermatophilus* under control somehow related to the SmartRide-Rx technology? I don't know, but it's the only thing that's different.

Water Consumption –

I have noticed that my horse's daily water consumption while in the stall seems to be less than last summer. Some days he hardly drinks. He's only in the stall about 6 or 7 hours during the hottest part of the day. But most days during that time, he gets his daily ride. And, it's been a hot and humid summer here in western Virginia. The horse does his work. He sweats and he cools off. We keep a gallon bucket in the wash stall for the cat. In the past, this horse would go to the wash stall for a bath and drain the cat's water bucket. Lately, he hasn't done that much if at all. He hardly drinks in the stall. I know he drinks from the trough in the field; I have watched him. The water comes from a well. It tastes good. I drink it myself. The buckets are dumped and cleaned every day. I've tasted the water in the bucket. It tastes fine. He is not dehydrated. He licks his slab of Redmond salt, but he does not drink a lot of water from that bucket. We used to give him two buckets; now he has one. He might drink 2 gallons in that 6 or 7 hour period. The grass is green and lush, just like last summer. The hay is good orchard grass just like all year. He's about as interested in it as he ever is during summer -not much because the grass is green and lush. Grain is the same. Supplements are the same. I'd be worried but the horse isn't telling me I should be. I've known him most of his life and I know his habits. SmartRide-Rx? I don't know, but it's the only thing that's different.

Feet –

I ride a 17 hand thoroughbred with thoroughbred feet. I don't need to say much more. If you own one you get it. It's now July, and October needs to get here. But so far, only one lost shoe in the last six months. As always this time of year, the last 4 or 5 days before the blacksmith comes are nail biters, but so far so good. It's an improvement. Full disclosure, I feed a hoof supplement and I top dress feet with a sealer a couple of times a week. But the ravages of dew and rain-soaked grass and pounding on hard ground when it isn't raining always make for perilous shoe watching. Nothing new to this routine. SmartRide-Rx? I don't know, but it's the only thing that's different.

Muscles, ligaments and joints –

I'll just start with a list of the stuff that I am always watching and waiting to blow. Hocks with DJD, old high suspensory ligament injury (minor, but twice), and some odd, isolated "splinter" the vet says is living just below the skin on the front of the lower cannon area of the right fore. Yep, she saw that on ultrasound. Magic! This last doesn't seem to bother the horse, but we watch it, wrap it to ride and ice it when we're done out of an abundance of caution, because we know swelling is an invitation for mischief, especially in a teen-aged horse. As for the ligament, so far, there is no new issue. Hock injections happen about once a year. We are coming up on the anniversary of that procedure. If we get through August with no injections, then I will be completely convinced that the only thing that's different is the only thing that will have mattered – SmartRide-Rx.

And Now for a Theory

As you can see my observations relative to the horse's physiology that might be affected by the saddle represent a diverse population of systems – cardiovascular, respiratory, immune, musculoskeletal, central and peripheral nervous systems, skin and hoof. I have read and researched for over a year to come up with some common denominator, some highly conserved mechanism that might explain these effects. In short, I didn't come up with a uniform theory. I dug into receptors and cell wall channels, cell wall pumps, neurotransmitters and mechano-baroreceptors. Nothing was ubiquitous enough or well-understood enough to explain such diverse effects. Mr. Coffin had suggested, from his similar observations, that what we were seeing might be explained by something as omnipresent and necessary, yet poorly understood, as water. This sent me down the rabbit hole of all the ways that water can be modulated, treated, ionized, re-structured, ordered and so on. In short, there is a lot of theory out there but not much real scientific evidence. That's just my opinion, but being a scientist by training, I am a sceptic.

True scientific cause and effect is a fleeting destination. But, I did come upon an intriguing theory postulated by Dr. Gerald H. Pollack, Professor of Bioengineering, University of Washington, Seattle. His interests range broadly from cardiac dynamics and electrophysiology to muscle contraction and cell biology. Dr. Pollack suggests, and backs it up with some pretty elegant research, that water has a fourth phase. This idea is not new. In fact, some version of it was postulated in the early 1900's. According to Pollack, this fourth phase of water behaves like a polymer gel. Dr. Pollack proposes that the interior of the cell, the cytoplasm, which is predominantly water, is also structured like a gel and has the same properties. The water molecules are structured or ordered in layers forming a matrix which makes water's positive charge more available to the proteins in the cell. Proteins are water loving because protein has a net negative charge. The proteins and the water constitute the gel.

So, back to water. Based on Pollack's theory, water has four phases – liquid, gas, solid, and gel. The gel phase of water is the state which lies somewhere between liquid and solid. In this state, water is ordered and has affinity for surfaces. This structure depends on the positive charge of the 2 hydrogen molecules and the negative charge of the one oxygen molecule and their ability to donate charge to nearby proteins. This gel phase is somewhat unstable – more stable than water, less stable than ice. In this state of moderate stability water can 'donate' a positive charge. Remember that the cell is packed with protein. Proteins do a very great percentage of the cell's work and are integral to energy production; neurotransmission; transport of solutes, nutrients, and cell waste; muscle contraction; cell division; etc. Proteins are negatively charged on the exterior. This negative charge makes protein highly hydrophilic (water loving). Cellular proteins are also highly structured. Think of the muscle cell (sarcomere), arguably the most organized of mammalian cells, built to do one job – contract- and then to relax. The proteins of the muscle sarcomere are almost rigidly organized as compared with synthetic gels which are typically built of tangled polymers with little apparent order. The protein of the muscle is predominantly of two types – myosin and actin. Both are highly water loving. In fact, actin is probably the most highly conserved protein in mammalian physiology and it is found in some form in every cell. This protein structure is of significant importance in how its association with ordered water can produce a response to stimuli which is both rapid and decisive. Under Dr. Pollack's theory, it is this protein water association which drives all of the basic cell functions.

The framework of the theory lies in the cell cytoplasm's similarity to the polymer gel. Both are built of cross-linked polymers; both contain ordered water; both exclude large solutes; both exhibit sizeable electrical potentials; and both have the 'feel' of a gel. If we can equate the character and function of the cell to that of a gel, then one can ask whether this can lead to a common paradigm for the cell's many actions.

The principle cell dynamics are secretion, production of action potentials which drive neurotransmission, transport, cell division, and contraction. According to Pollack, every one of these functions can be driven and recovery from the resulting action is promoted by how water and its various chemical configurations interact with the charged proteins in the cell by a process called phase transition. It's complicated and I don't pretend to be able to fully explain it. For the intrepid student refer to Dr. Pollack's excellent book- **Cells, Gels and the Engines of Life.** [1]

The cell's interior, the cytoplasm, has a net negative charge. This charge is primarily due to the abundance of proteins within the cell. So-called ordered water, ie, the

[1] Cells, Gels and the Engines of Life, Gerald H. Pollack; Ebner & Sons Publishers, Seattle, WA, USA; 2001; pp 113-129.

fourth phase of water, exists in the vicinity of these proteins, readily positioned to initiate the phase transition leading to a number of functions and then to reset the system to make ready for the next stimulus. Any number of stimuli may trigger the phase transition – change in pH, temperature, chemical or biochemical agents, salts, electrical fields, mechanical stress, electromagnetic radiation. Stick a pin in this.

How Does the Saddle Come Into Play?

Looking back at that list of stimuli given above which may produce a cellular phase transition, there are only two which might be relevant to the saddle – change in electrical field or electromagnetic radiation. The saddle is an external instrument resting on the horse's back. It cannot, in and of itself, produce a change in pH, temperature, chemicals or biochemical, salts or a mechanical stress which might produce the cellular responses outlined above.

The SmartRide-Rx saddle tree is composed of a polymer and carbon fiber, melded together in a patented process and then covered in padding and leather. It looks like most other saddles on the outside. This tree, however, is not doing ordinary things. Without doubt, it is designed to move with the horse. This alone should make the horse more comfortable, and therefore, more efficient in its work. However, how does this explain the other physiological effects observed – faster recovery from exercise, improved skin condition, reduction in muscle pain and fatigue, relaxation, improved attention to instruction? These effects originate in diverse physiologic systems – cardiovascular, pulmonary, integumentary, musculoskeletal, central and peripheral nervous – leading the observer to conclude that the effect, whatever it is, is not specific. What stimuli are left to consider? Only two remain – change in electrical field or electromagnetic radiation.

Mr. Coffin has determined that the saddle tree emits a field of energy and this field is approximately 9 cubic feet in area, that is, a three dimensional field above, below, in front of and behind the saddle. The field has a left and right hemisphere, and these merge in front and back. This field appears to generate a radiant energy in the infrared range as crudely detected with an adaptor for smart phone camera. See Figure 2.

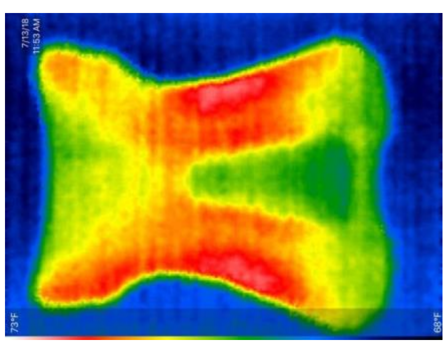

Figure 2 – Saddle tree photographed at ambient temperature with infrared lens attachment

Based on Dr. Pollack's theories, we remember that one of the stimuli which triggers phase transitions in the mammalian cell was electromagnetic radiation (EMR). In the last decade, there is emerging evidence in the medical literature which suggests that EMR in the infrared range (just beyond the long wavelength red edge of visible light) promotes the production and function of ordered water (also commonly referred to as ordered water, concentrated water, nanostructured water, structured water). Externally applied EMR may selectively target the organization of this ordered water to effect biological functions. Existing data have not yet unequivocally proven the role of ordered water in modulation of cellular function, but research does show that such water can store charge and can later return it in the form of intracellular current flow with as much as 70% of the input charge being readily available. This charge in the ordered water is stable for days to weeks.[2] Dr. Pollack and others have demonstrated that radiant energy in the far infrared range (FIR) can order the water that possesses the structured arrangement which promote these cell functions by phase transition.[3] In 2016, a group of researchers proposed that EMR in the infrared range can produce light-water interactions stimulating the cell to generate high energy molecules such as adenosine triphosphate (ATP) which supply energy for cellular functions including metabolism and signaling.

We are surrounded by infrared radiation (IR). Remember, the sun generates this energy. We cannot see it, except with a device which detects it, because IR lies outside the range of visible light on the electromagnetic spectrum. See Figure 3.

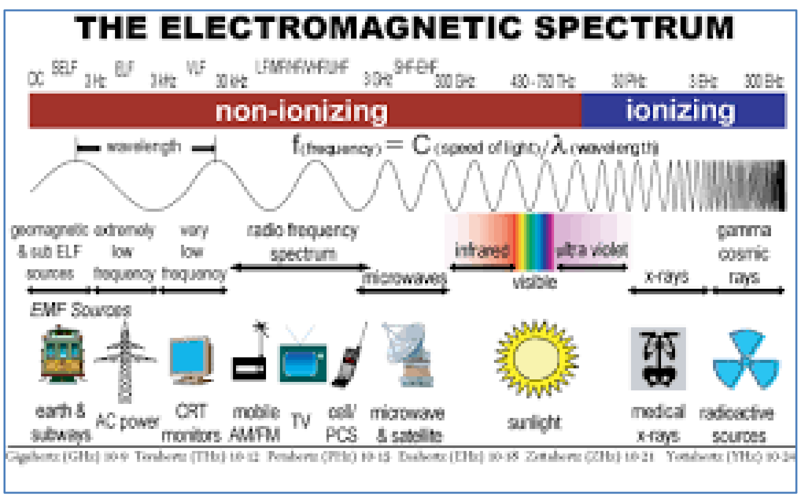

Figure 3

[2] Santana-Blank, L., Rodriquez-Santana E., Santana-Rodriquez, KE. Photobiomodulation of aqueous interfaces:finding evidence to support the exclusion zone in experimental and clinical studies. Photomedicine and Laser Surgery. 2013;31(9);461-462.

[3] Pollack, G H. Cell electrical properties: reconsidering the origin of the electrical potential. Cell Biology International, 2015; 39(3): 237-242.

The source of energy in both the visible and infrared (IR) portions of the EM spectrum is the sun. Objects absorb and reflect that infrared energy. A review of the available literature indicates that far infrared energy (FIR) has the greatest likelihood of producing the diffuse biological effects detailed above. Medical researchers have developed instrumentation to deliver concentrated IR energy from the near IR (NIR) to the far IR (FIR) range such that tissues may absorb and/or reflect IR energy. These instruments are often as simple as infrared heat lamps emitting in the NIR range and as sophisticated as specialized far infrared lamps which utilize ceramic emitting panels that remain cool to the touch. The infrared energy emitted by these panels would be absorbed by the target tissues. One comparative study showed that FIR therapy reduced symptoms of exercise-induced muscle damage in athletes after a simulated trail running race.[4] A study of patients with rheumatoid arthritis and ankylosing spondylitis showed a reduction in pain, stiffness, and fatigue during infrared sauna therapy.[5]

Conversely, the body itself is a reflector of absorbed, ambient infrared energy. FIR emitting materials such as the boron-silicate mineral, tourmaline, when milled into fine powders, can be incorporated into fibers to make fabrics which can be applied to various body areas. Infrared energy being reflected off of the human body is believed to be transferred to these materials which are acting as "perfect absorbers" which then emit FIR back to the body. Since this is a thermodynamically neutral process, there is little risk of excessive heat production which might cause tissue damage. FIR emitting ceramics have been shown to delay the onset of fatigue in a simulated skeletal muscle contraction model[6], to reduce foot pain and inflammation in human patients with diabetic neuropathy[7], and to suppress proliferation of some types of cancer cells.[8]

What does all this have to do with a saddle tree? I postulate that the materials in this tree, as constructed, are either emitting EM radiation in the FIR range, and/or are acting as so-called "perfect absorbers" of the FIR energy being reflected by the horse's and the rider's body. Whichever the mechanism, the resulting energy is sufficient to slightly perturb the ordered water matrix along the cell's proteins such that phase transition can occur. These phase transitions then lead to the various mechanisms

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[4] Hausswirth C, Louis J, Bieuzen F, et als. Effects of whole-body cryotherapy vs. far-infrared vs. passive modalities on recovery from exercise-induced muscle damage in highly trained runners. PLOS One 2011; 6(12):e27749.

[5] Oosterveld F G, Rasker J J, Floors, M, et als. Infrared sauna in patients with rheumatoid arthritis and ankylosing spondylitis: A pilot study showing good tolerance, short-term improvement of pain and stiffness, and a trend towards long-term beneficial effects. Clinical Rhumatology 2009; 28(1):29-34.

[6] Leung T K, Lee, C M, Tsai S Y, Chen Y C, Chao J S. A pilot study of ceramic powder far-infrared ray irradiation on physiology: observation of cell cultures and amphibian skeletal muscle. Chin J Physiol 2011; 54(4):247-254.

[7] York R M, Gordon I L. Effect of optically modified polyethylene terephthalate fiber socks on chronic foot pain, Biomed Central (BMC) Complementary and Alternative Medicine; 2009;9:10.

[8] Ishibashi J, Yamashita K, Ishidawa T, et als. The effects inhibiting the proliferation of cancer cells by far-infrared radiation (FIR) are controlled by the basal expression level of heat shock protein HSP 70A. Medical Oncology 2008;25(2):220-237.

that produce the multitude of mitochondrial and cell functions that led off this discussion.[9] Phase transition may be a common mechanism among many cellular organelles. It is simple –on or off, and it is powerful in its effectiveness. A subtle environmental change triggers an immediate and massive response.

Cellular protein and the ordered water which surrounds these proteins and the surfaces of other cellular organelles require energy to maintain order. In fact, some of the cell's energy is stored in the form of order. Consider the muscle cell. Initially, water is ordered around thick and thin protein filaments. These filaments lie in their extended, high potential energy states. Following some stimulus, order gives way to disorder. As filaments contract and surrounding water is released into disorder, potential energy is given off in the form of mechanical work and heat. Then the system must be re-primed. The filaments need to be restored to their lengthened state and water needs to be restructured. Re-ordering requires energy. Where does this energy come from and how is it used to create structural order? Enter adenosine triphosphate (ATP).

ATP has very high affinity for proteins and is highly charged. Due to this charge, ATP is able to shift the electron cloud of adjacent atoms, which, in turn, shifts the cloud of a subsequent atom and so on. Through this sequential action, binding of ATP produces protein extension which is reinforced by water structuring. Because ATP binding is so tight, the energy stored and released is substantial. It is this protein bound ATP, ordered water, energy building cellular machine which keeps the extended protein ready to respond to whatever stimulus will generate it's specific action.

ATP probably initially arose from the primordial ooze. Here we go back to the proverbial big bang theory of evolution. Under the prevailing atmospheric conditions, and under the influence of the sun's energy, experiments have shown that ATP could be created in much the same way that amino acids and DNA could be created. Unfortunately for that first assembled gel of life, atmospheric oxygen was still in short supply. The first cells had to rely on very low-yield anaerobic (without oxygen) processes to generate ATP. Basically there was probably just enough ATP to keep this emerging biologic system alive.

The landscape changed with the arrival of atmospheric oxygen. As primitive cells began to release oxygen from photosynthesis to the atmosphere and as volcanic activity subsided, reductive gasses began to be replaced by oxygen. Metabolism could use that oxygen. Certain unicellular organisms such as bacteria began to utilize oxygen to produce ATP. ATP is produced on the bacterial surface. That surface, is, therefore, heavily negatively charged because ATP is negatively charged. Turns out, at some point on the evolutionary curve, one of those primitive bacterial cells which

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[9] Sommer A P, Caron A, Fecht H J. Tuning nanoscopic water layers on hydrophobic and hydrophilic surfaces with laser light. Langmuir 2008; 24(3):635-636.

had learned to employ the new oxygen-based metabolic system to produce energy in the form of ATP invaded a larger cell that had not. This was the first cellular organelle. We now know it as mitochondria, because that invading bacterium stayed, and it knew how to make ATP.[10]

The invader's high negative surface charge in the form of ATP could order the host cell's water and water ordering could then induce extension of nearby host cell proteins. As long as oxygen could diffuse through the host cell to fuel continuous ATP production, the invader could be exploited to produce potential energy for the host cell. This scenario is supported by nuclear magnetic resonance studies which demonstrate water structuring inside and outside mitochondria.[11] That single cell bacterium now evolved to single-mindedly produce energy for the host cell in the form of ATP. The rate of energy production was further enhanced by the development of in-foldings in the mitochondrial wall called cristae, and these enlarged the surface area for the production of ATP. Mitochondria multiplied in number and became positioned adjacent to the most aggressive consumers of energy –proteins. With the mitochondria now efficiently producing sufficient supplies of energy, the host cell could turn its attention to specialization.

Once bound to intracellular protein, ATP's strong negative charge lengthens or extends the protein. This lengthened protein orients its negative charge to the outside and water in the vicinity is ordered. The resultant order holds energy. The system is now primed to do work. As some stimulus comes along and discharge of the potential energy of this order occurs, ATP is split into adenosine diphosphate (ADP) and phosphorus. ADP is less negatively charged than ATP, so it is forced off the protein and moves down its concentration gradient to the nearby mitochondria so that more ATP can be produced. Note here that this cycling of ATP is also the cycling of charge. With each ATP that binds to protein, the protein gains negative charge. Water in the vicinity is ordered according to this negative charge. This negative charge on the protein builds but not indefinitely. The protein must eventually discharge and this occurs when ATP breaks down to ADP and phosphorus. The protein is returned to its discharged state and the cycling of ATP and protein recharging follows. So, the protein is charged to accumulate energy and discharged as some action such as contraction, secretion, ion transfer, etc. is produced. So the cell is an energy machine. It prepares for action by building and maintaining order and then releasing energy as some stimulus discharges or disorders the system. This ATP cycling is fundamentally what drives the phase transition- a newly proposed model of cell organelle function.[12]

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[10] Martin, W F, Mentel, M. (2010) The Origin of Mitochondria. Nature Education. 3(9):58.
[11] Lopez- Beltran, E A, Mate, M J, and Cordan, S. (1996). Dynamics and environment of mitochondrial water as detected by H NMR. J. Biol.Chem. 271(18): 10648-10653.
[12] Pollack, G H. (2001) Cells, Gels, and the Engines of Life; a New, Unifying Approach to Cell Function. Seattle, WA: Ebner and Sons. Ch. 15.

The various forms of phase transition have a common component - cooperation. Transitions are not singular molecular events, but rather global actions. Once a critical threshold has been reached, the transition occurs instantly and cooperatively among the components structures. Remember the cell is full of proteins and ordered water. In fact, any cell structure which has predominantly negative charge on its surface can serve to order water. The cell membrane itself orders water because the membrane has a net negative charge. Mitochondrial surfaces are highly negative, and ordered water has been demonstrated on mitochondrial membranes. [13] This interaction between negatively charged surfaces and intracellular water literally build the gel of the cell's interior and holds it together. The interaction between negatively charged proteins, driven mostly by ATP, orders water and creates energy.

The phase transition has a variety of transition forms. This variety reflects the diversity of tasks a cell must perform - permeability change, ion transport, solute expulsion, shape change, force generation, strand shortening, etc. Condensed energy-loaded vesicles are ideal for secretion; helix-coil transitions work well for contraction against loads; condensation from extended coils produce large scale length changes ideal for transport and cell migration. Diverse types of transition meet diverse functional needs of the cell such as respiration, neuronal transmission, toxin and metabolite elimination, contraction, nutrient uptake and metabolism, etc. As such, the phase transition is a simple and powerful process triggered by small environmental shifts in pH, temperature, pressure, ion content, mechanical stress, electromagnetic radiation, etc.

The theory postulated here is that this small environmental shift is produced by far infrared (FIR) energy produced by the materials used to construct the SmartRide-Rx ™ saddle tree. The cycle is as follows:

Process 1

FIR → ↑ATP production →protein binding displacing ADP → protein extension, high negative charge → ↑water ordering = energy = ready for phase transition to perform whatever the cell needs to do instantaneously

Then, Process 2

ADP + P returns down gradient to mitochondria → ATP production leading to Process 2, and so on….

If the saddle material is emitting FIR energy then any cell within this field should be more efficient in its function due to augmented mitochondrial respiration, ie, ATP production. Mitochondrial membranes are believed to order water. IR therapy has been postulated to cause small perturbations in mitochondrial membrane structure

[13] Trombitas, K., Baatsen, P., Schreuder, J., et als. Contraction-induced movements of water in single fibers of frog skeletal muscle. J. Mus. Res. Cell Motil. 14:573-584/

by way of nearby intracellular Ca^{2+} which is theorized to initiate the contraction of proteins to which ATP is bound and around which water is ordered. The second common feature of phase transition is the involvement of divalent cations of which Ca^{2+} is by far the most prevalent. Calcium condenses the protein-water matrix and squeezes out the water. The protein contracts and stored energy is released. Work having been accomplished, ATP is regenerated and binds to the protein lengthening it so water can be re-ordered and order/energy is restored. The structure is ready to go again.

With respect to this theory, the most useful question to be answered is the characteristic(s) of the wavelengths being emitted or reflected by the SmartRide-Rx tree. At the cellular level, the underlying biophysical mechanisms of the interaction of electromagnetic radiation with living cells can be understood in terms of altered cell membrane potentials and altered mitochondrial metabolism, ie, ATP production.[14] There is more work to be done. Stay tuned.

Recommendations for Use in the Horse

Based on my use of the saddle and observations of its effects and observations made by the manufacturer in field trials over many years and rides, I have the following recommendations for use of the SmartRide-Rx saddle for the typical horse in work.

Application

I tack up my horse in this saddle every day for a minimum of 30 minutes. I utilize the pad or pads which work best for my horse's anatomy, determined by trial and error and generally following the directions of the manufacturer. My horse is loose in the stall, free to eat at will. Usually by the 10 minute mark, he 'naps' as evidenced by leaving hay, lowering the head and drooping of the eyelids and often lower lip. These effects are similar to those which are often seen with acupuncture treatment or massage. Heart rate lowers to about 70% of normal resting rate. At the end of this period, which I find may be reduced to 20 minutes if necessary, I finish tacking up and proceed to ride if it's a riding day. These observations are consistent enough that if one does not see these effects and there are no other distractions which may be affecting the horse's demeanor or comfort (like a missing pasture buddy or delivery of a load of hay, etc.) one should probably give the manufacturer a call.

Interestingly, I have <u>not found</u> that the 'sleepiness' which occurs as the horse is standing around in the saddle continues once we get to work. If you have ever ridden a horse that has been tranquilized, you know what it feels like – sort of lazy off your

[14] Sheppard, A R, Swicord, M L, Balzano, Q. Quantitative evaluations of mechanisms of radiofrequency interactions with biological molecules and processes. (2008) Health Phys. 95(4):365-396.

leg and dull. I imagine it would be comparable to how humans feel after taking an anti-histamine or valium – sleepy and slow. The horse at work in this saddle is alert and ready to work, not at all dull.

Even on days when I can't ride, and winter time is full of those, I try to put this saddle on my horse for at least 30 minutes a day. My observation has been that I can go for days without riding, or get a ride in every other day if the weather cooperates, and my horse doesn't seem to lose fitness. I have talked with other users of this saddle who report the same impression. If real, this effect is helpful in all horses, but should be especially beneficial for the young horse just learning and the older horse with known musculoskeletal problems such as chronic degenerative joint disease or old tendon/ligament injuries.

Conclusions on My Year in the SmartRide-Rx Technology

I think my horse is healthier. In general, he is calmer. He's pretty calm to begin with, so the casual observer might not notice much difference. But I have had this horse for 14 years and I know the difference.

I find that my horse is less distracted in his ring work and less of a spook when hacking out either alone or in company. This saddle makes me feel more secure and spooks on the horse's part are less worrisome to me. This was a real surprise since I rode for years in a rather deep-seated, all-purpose saddle chosen because it should have made me feel more secure. Go figure! Let's face it, if the horse finds something scary to jump at, he's also 'listening' for the rider's reaction. If I am not worried by his reaction because I am more secure, the horse's spook matters less to me. I can ignore it and ride on and the horse, sensing no bother on my part, just decides there's nothing to see here and moves on. I would imagine that the act of jumping away from something deemed scary will abruptly put the horse's back up against the saddle, any saddle. If there's no resulting physical discomfort and the rider doesn't move or overreact, then the horse is free to just move on. In all phases of riding, I would describe the feeling that the rider achieves is one of "being in the saddle instead of on it". I will note here that if the saddle is not doing its work effectively, one of the signs can be a spookier or more distracted horse. If you notice this change, call the manufacturer. DO NOT HESITATE! CALL!

At first use of the saddle, I found that my horse went through about 3 rides where he experienced what I would describe as questioning, almost as if to say, 'What is this new thing?' I call what I noticed a testing stretching. The rider feels the horse sort of tentatively stretch out through the back. And, I would imagine, not finding resistance or a 'hard stop' coming from that thing he is wearing, he lifts his back up into this saddle instead of meeting resistance with resistance. That is the only way I can describe the feeling. By about day 3, the back is coming up just about as soon as you walk off. The stride is lengthening and the horse's attitude is softer. He has learned that resistance is not needed. He doesn't have to adjust to find a comfortable place to be. I noticed right away that upward and downward transitions became smoother and more 'through the back'.

As to jumping, the horse went forward more readily to the jumps, felt rounder over the jumps, and felt softer both on take-off and landing, coming right back after landing - just less resistant in all aspects than in my previous saddle. In general, I find that the horse 'hears' my instruction and I can feel him 'answer' sooner. This has really forced me not to 'over-ride' the jumps and to feel that I can wait for the 'fence to come to me'. I think this is just the result of being better able to maintain a consistent stride because the horse is hearing and answering more quickly and efficiently. I imagine this would apply to all riding disciplines.

In my experience, if your horse is getting regular massage, chiropractic adjustment, acupuncture treatment, joint supplements or injections, etc., those treatments should not be discontinued, particularly in older horses with known orthopedic challenges. You may find, as I have, that your horse does not need these treatments as frequently. Horses that work hard, and particularly those that travel and/or horseshow frequently, will still benefit from these therapies.

This equipment is not tolerant of extremely cold temperatures. If your tack room is not heated in winter and the temperatures in your barn are below freezing, it's probably best not to store the saddle in the barn or in a horse trailer. Consult the manufacturer for recommendations. You have invested not only in advanced technology for communicating with the horse, if my theory is correct, you have also given your horse better overall health. Could it be as simple as just improving the production of the cell's energy? Why not? Don't forget good old ATP, ordered water, and the phase transition. Nature loves simplicity.

Treat this saddle as you would that smart phone appendage. You will be rewarded with a more comfortable horse, happier and more responsive in his work. And, that horse is just more fun to ride. Happy trails!

