# UNBREAKABLE

## STRENGTHENING Ones JOINTS According To SCIENCE

**Over 100 Illustrated Exercises**

**JEAN-LUC ANDRE (Pt.)**

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# FOREWORD

*The information contained in this book is based on science (the numbers in brackets refer to the studies cited at the end of the book). It is easily verifiable, either by consulting the bibliography or by doing a bit of online research. A small part relates the results of coaches and athletes or is based on my own experience.*
*Who is this book for? Anyone who wants to better understand their body and develop strong joints by freeing themselves from chronic injuries or reducing their risk of future injury. Physiotherapists, coaches, and athletes who want a practical manual on prevention.*
*With modern lifestyles having made joints one of the weakest links in the human body, knowing how to strengthen ligaments, tendons, and cartilage, as well as preserving the body's elasticity, is a major asset in performance as well as in the fight against aging.*

*A glossary at the end of the book clarifies the technical terms.*

# INTRODUCTION

I am passionate about sports, but in my thirties my joints gave out on me one after the other. The first in the series of injuries was the fracture of my scaphoid in a roller-skating fall. Not long after that, I began to experience hip pain; a year later, it was a supraspinatus tendon tear while lifting dumbbells. Finally, I ended up the series first with knee sprain while skiing and a tennis elbow. Were these injuries due to sporting excesses? It may well have, but high-dose sport isn't necessarily destructive. For example, surfer Kelly Slater continues to collect titles at the age of 51, as does former Patriots quarterback Tom Brady, who remained at the top of his game until his retirement at the age of 45 in a high-risk sport for injuries. Zlatan Ibrahimovic, despite cruciate ligament problems, stunned his surgeons with the robustness of his knees after 23 years as a striker. Even if genetics play an obvious role in sporting longevity, these athletes clearly do something better than others. Avoiding injury is a skill that anyone can acquire, but one has to know how.

In my search for a solution to slow down, or even reverse, the ageing of my joints, the advice of an eminent Parisian rheumatologist wasn't much help, as he encouraged me to limit myself to swimming, cycling and Pilates, when in fact self-restraint is the worst option: "Use it or lose it', as they say in the States. Indeed, the impacts of running may not be as harmful as previously thought - studies show that joggers have larger intervertebral discs than the rest of the population" (2). Why should you give up your passion for a sport you don't really enjoy? It would be wiser to adapt the intensity and duration of your training to stay below the pain threshold, while strengthening your joints at the same time!

Unscrupulous individuals dangle miraculous herbal solutions in front of patients. These certainly have many benefits but having tried many of them: from turmeric to devil's claw to rare Amazonian plants, none of them had any convincing effect on my joint pain, including supplements that have been validated by studies, such as glucosamine and chondroitin. For some people, giving up dairy altogether has enabled them to get rid of chronic tendonitis, but there's no proof that this will work for you, especially if you're not lactose intolerant. To my knowledge, there is only one effective supplement for joints, and the good news is that it's easy to obtain. It's an adjuvant, not a substitute for rehabilitation, and you won't feel the effects until you've been on it for at least three months (see the section on diet). An anti-inflammatory diet, as well as the use of supplements with analgesic or anti-inflammatory properties (turmeric, MSM, etc.), and the intake of vitamin D—studies have established a link between its deficiency and musculoskeletal disorders (McBeth et al., 2010)—are other rational precautions to relieve pain.

The real solution to keeping your joints in perfect condition is to diversify your motor patterns,i.e. your range of movement, just as a singer expands his vocal range by practicing scales.

You should also tone up your fascia every day to take the strain off your joints. Just as you train (I hope) your muscles and your heart, devote ten minutes a day to strengthening your joints, and they will support you for the rest of your life. The closer the muscles are to the joint, the more important they are for its health. Consequently, the rotators must be systematically trained for joint health (except for the spine, which works differently). But we only train them when we're injured, which is a mistake.

I often ask myself the question: why are we so stiff in the way we move, compared to animals? "For example, an animal can remain motionless for hours on the lookout and then sprint without muscle strain. We're under constant stress, and unlike animals, whose cortisol levels soar in situations of fight or flight, but quickly return to normal once the danger has passed, the shocks of life tend to leave an indelible imprint on the human body.

But the tensions that accumulate throughout life, to the point of saturating the muscles, do not explain the stiffness and lack of coordination displayed by the vast majority of teenagers during sporting activities. Is this the fault of our lifestyle, which is too lacking in movement, both qualitatively and above all quantitatively? I'm personally convinced of this. A hyper-secure environment that encourages immobility is the antithesis of that in which a wild animal evolves, where obstacles and variety stimulate the development of its full potential.

So, it's not surprising that we all suffer, to varying degrees, from joint pathologies, because we move too little and according to patterns stereotyped by our profession or the sports we play.

By devoting just seven minutes a day to stimulating the development of our ligaments, bones, and tendons, we can make ourselves much less prone to injury. Not all of them are avoidable, of course, but many can be, provided we are proactive.

By the way, the goal is not to never get injured, otherwise there is a risk of developing hypervigilance and fear avoidance in situations incorrectly perceived as potentially dangerous, such as fun and playful activities or those involving an element of chaos. It is rather to become resilient meaning resistant to inury in the sens to be minimally affected by them and to recover stronger and quickly as possible (jumping forward instead of jumping back).

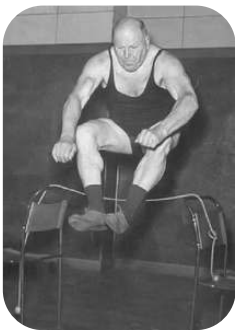
Furthermore, one must avoid having too narrow a conception of the range of movements that are 'correct' and 'risk-free', as this may dissuade us from engaging in certain activities where total control is impossible, such as team sports, contact sports, competition, thereby contributing to an internal perception of ourselves as fragile.

# PART ONE: PRINCIPLES OF PREHABILITATION

## Avoiding the Pitfalls of a Sedentary Lifestyle at Work

Your joints need constant (but not necessarily intense) activity. Optimize your workspace, as this is where you spend most of your waking hours! Ideally, you should be able to alternate between standing and sitting at two desks, install a small pedal under your desk to keep your legs moving constantly, and get up every 45 minutes, using sound reminders, to spend a few moments walking, hanging from a bar, or doing twenty squats. This basic form of exercise is said to be effective in preventing pathologies linked to prolonged immobility. One hour of intensive sport is not as beneficial as 12 times of five minutes of exercise, spread throughout the day.

## Elasticity and Strength, the Yin and Yang of a Functional Body



According to a Russian saying, you're old when you can't jump any more, because to do so you need an elastic body, a rare quality after the age of 30. If the strength exceeds the elasticity of the body, injuries will occur. Hackenschmidt, a wrestler in the first half of the 20th century, could jump over a rope stretched between two chairs at the age of 75 (photo). Elasticity peaks in children and then decreases if it is not maintained. Unfortunately, few physical trainers are aware of its importance.

Tissue elasticity depends on a number of factors. These include nutrition, hydration, sleep quality, cellular permeability, mitochondrial function, vascularization, oxygen saturation, mobility, VO2 max, motor patterns and, of course, the optimal organization of collagen fibers (poorly repaired old injuries often cause fibrosis, which is a source of stiffness). This quality is maintained through myofascial massage (foam roller, Lax Ball etc.), training on unstable surfaces, the use of 'soft' weights (sandbags etc.), elastic bands, isometric and eccentric work. There are enough videos on YouTube of massages with foam roller that I won't dwell on them any further. Their function is to keep muscles long and supple and this is particularly important if you're doing bodybuilding, as it tends to produce the opposite effect. Let's not confuse stretching, mobility and pliability. Stretching is passive: if after a 20-minute warm-up I can do a split, I'm flexible, but being able to lift my leg 90° in a standing position shows good mobility, because in this case the range of movement is controlled by my muscles and not by gravity. Doing it without warming up shows pliability, i.e., long muscles even at rest, after all there are situations in life when you don't have the leisure to warm up, when someone attacks you in the street for example or you have to sprint to get to an important appointment on time.

## The Iron Law that Charlatans Hide From You

The brain produces pain (not the site of injury). Pain is modulated by the situation, similar past experiences, emotional state, location, and beliefs. If you sprain your ankle when you're traveling and under stress, it will seem more painful than if you sprain it at home surrounded by your family. Therapists have a duty to speak to their patients in a non-anxiety-inducing way, to avoid the 'nocebo' effect (the opposite of placebo). Telling a patient: "Your back's in tatters!", by pointing to the abnormalities in their X-ray, is tantamount to aggravating their symptoms, or even creating them from nothing. Maintaining regular physical activity and trying to ignore tolerable pain as much as possible helps to raise the patient's pain tolerance threshold. The brain is like an overprotective mother who will be reassured if you show her that you can play without hurting yourself. Any painful signal, repeated over time, strengthens the nociceptive synaptic connections and tends to become chronic, to persist even when the initial cause has disappeared. What's more, tendon rehabilitation is slowed down by cortical inhibition, which inhibits muscle contraction when it is perceived, rightly or wrongly, as dangerous. Hence the importance of using a metronome during eccentric or HSR (Heavy Slow Resistance) exercises to get around this cerebral brake by pre-activating the muscle (your muscle activates before the cerebral command). Neuroplasticity (macro aspect) should not, however, overshadow bioplasticity (micro). Unlike the nervous system, which adapts quickly, biological tissues need to be stimulated for a long time to change. If you are 50 years old and have been stooped all your life, no amount of manual therapy, motor reprogramming or postural T-shirts will improve your posture in the long term. You will have to go through a long phase of corrective exercises, aimed at correcting the structural changes your body has undergone. The sign of a quack? They always offer a quick, effortless 'solution' to a chronic problem. What took years to establish will also take time to disappear. The best approach is to work on both bioplasticity and biopsychosocial conditions (basically your emotional well-being), to raise the pain threshold.

## Correlation between Bone Density and Strength

With thin bones, you have little chance of shining in certain sports. A weightlifting coach told me that the reason why some beginners explode in performance in just a few months is because of their bone structure; big bones are an asset for heavy lifting, and the reverse is true: training heavy increases bone density, but someone born with thin bones will never become solidly 'built', even if they do increase their bone density a little through exercise. According to science, scrum-halves and American football quarterbacks have massive vertebrae and dense bones, as do boxers and Mixed Martial Artists (MMA) (6) who have to withstand the violence of contact.

Conversely, golfers need thin vertebrae for better rotation during the swing, and professional swimmers have low body density, which makes them easier to float. In swimming clubs, coaches often give beginners a buoyancy test, which consists of staying upright and motionless in the water. Some of them sink up to their heads, while others, of lesser density, effortlessly manage to keep their heads and sometimes their shoulders out of the water. The latter have an advantage in that they glide effortlessly through the water, rather than having to 'grind' constantly to stay afloat.

## Two Divergent Trajectories: Kobe Bryant and LeBron James

Basketball is second only to American football in terms of injuries. Violent contact or poor reception (internally rotated hips, inverted feet, etc.) cause micro-tears that can turn gangrenous. Kobe Bryant, an American basketball legend, is a perfect illustration of this, with injuries all over the place, including multiple fractures, knee and shoulder surgery and a ruptured Achilles heel. Another NBA star, LeBron James, has never had a serious injury in his career, apart from a pulled muscle. How can this paradox be explained? Thanks to his extraordinary fascias, Lebron James can land one-meter jumps without joint stress. The fascias form a sort of "rubber" suit that protects the joints. This is the secret of his sporting longevity, along with (in his case) meditation, mobility work and the use of a hyperbaric chamber (29)

*Fibroblasts, the cells that make up fascia, must be subjected to a unidirectional force for 2 minutes in order to adapt (lengthen or thicken). This can only be achieved by long stretches or isometric contractions.*

## The Question of Intermittent Muscle Activation

As a result of sitting too much, the buttocks suffer delayed activation, known in physiotherapy jargon as "muscle amnesia", which can predispose you to back or knee pain. What does this mean? When they need to contract to support your back, for example when you bend forward, they don't do so in time. Strengthening the glutes (the largest muscle in the body), the source of all performance, is a priority in physical preparation. A few years ago, I trained them daily at the gym, but despite their obvious hypertrophy, I had to concentrate on activating them when I did squats, otherwise my quadriceps would take over. The same phenomenon occurs with the tibialis anterior muscle, which locks the ankle and decelerates running; it's only active intermittently. We can't rely on muscles that wake up every other time and bombarding them with stimuli by dramatically increasing their workload doesn't solve the problem. The solution is to create a permanent neurological link, so that a slight tension in the arch of the foot automatically activates the glutes via the fascia chains. In this way, they are constantly in 'On' mode, without you having to think about it. If you're interested in this subject, and want to improve your relaxation, I recommend Chong Xie's 'Secret of athleticism' videos based on plantar 'hyperarch'. I don't agree with everything he says, but he's put his finger on something interesting. A basketball player like LeBron James has spontaneously developed this neurological link that allows him to perform impressive jumps that defy the laws of biomechanics, with just a little bending of the legs.

## How to Boost Synovial Flow to Accelerate Healing

In adulthood, tendons are poorly vascularized and feed mainly on synovial fluid. To stimulate their nutrition, the joint must be moved for a long time to "pump" as much synovial fluid as possible into the tendons. This also helps to improve their blood supply. To do this, use low resistance and don't be afraid to do thousands of repetitions. The bicycle (traditional or elliptical), the rowing machine and, for the upper limb, the 'arm cycle' machine in the gym, are ideal for this.

## Muscle Volume, an Overestimated Parameter of Strength

The strength of the muscle depends mainly on the diameter of the fibers (weighted by the recruitment of motor units (the nerve impulse), the angle of pennation of the fibers and the lever arm defined by the insertion of the tendon. However, without the extracellular collagen matrix holding the fibers together, they would slide over each other without producing synchronous contraction. Indeed, it has been observed that if collagen production is inhibited after a muscle-building session, the gain in strength is halved (9). As a result, collagen supplementation should never be underestimated in sport performance.

## Unbreakable or Lightning-fast thanks to Genetic Mutation

"Unbreakable", Night Shyamalan's famous film starring Bruce Willis, may not be a pure science fiction scenario. In 1990, an American was involved in a car accident that should have had serious after-effects (25). However, to the surprise of the medical profession, he survived with only minor scratches. Radiologists discovered that the man's bones were eight times denser than those of ordinary mortals, making them virtually unbreakable. This anomaly (or superpower) is due to a mutation in chromosome 11. Bone density is an asset in combat sports, but a handicap in swimming because it reduces buoyancy. The same goes for cycling, where it's better to be light to climb a mountain pass. MMA (Mixed Martial Art) champions generally have very dense bones (Yoel Romero or Justin Gaethje are examples), which explains their resistance to knockouts. Let's imagine for a moment that we could manage, through genetic mutation, to increase our bone density tenfold, we could survive many road accidents, reduce the risks associated with falls and grow old without fear of femoral fractures. Gymnasts are those with the highest bone density and it would appear that peak loads, i.e., landings (jumps, falls or acrobatics) on the feet or hands, increase bone density more than the progressive loads used in bodybuilding. Obviously, this method is only possible with perfectly healthy joints. On the muscle side, there is also a mutation in the ACTN3 gene (17) that increases performance, and it would appear that all Olympic-level sprinters have this mutation!

## The Importance of Responsiveness and Coordination in Injury Prevention

Sporting efficiency depends on the ability to sequence muscular contraction and relaxation and to synchronize muscles (co-contraction). When landing from a jump, you need to contract the leg and foot muscles before impact, because afterwards it's too late, as injury occurs in 50 milliseconds, which is not enough time to contract the peroneal muscles, which have a reaction time of 60 to 90 ms. Co-contracting muscles at the right moment, but also releasing them as quickly as possible, is a valuable quality in sports. For example, during a kettlebell swing, a ballistic movement, it is important that the initial contraction is as short as possible, otherwise it reduces the speed of the kettlebell, which takes advantage of the relaxation phase to rise more easily. In the eccentric (return phase), the glutes, back and abs should contract just before the handle touches the pelvis, for the reason given above. To develop your muscular coordination, which is fundamental in preventing injury, do plyometrics (agility scale for the legs, but also locomotion on uneven ground), jumps and the exercises I've listed under 'neuro'. For the arms, catching a medicine ball after bouncing on a trampoline or a wall is a very good exercise.to train this ability. To work on coordination and eye-hand coordination, you can also have fun bouncing a tennis ball against a wall with your fists closed, without letting it fall.

## The Tragic Fate of the "Gym Rats"

Most newbies in, bodybulding stagnate after a few years' practice, because of recurring injuries. Their muscle mass has developed well, but their joints have gone in the opposite direction. Any local weakness affects the whole: without the contraction of the small muscles of the plantar arch, the glutes can't activate 100%, and pelvic stability is compromised. By changing of paradigm, I've made more progress in the last year than in the last twenty.

Developing my motor control, concentrating on my weak points (a chain is only as strong as its weakest link) and not forgetting any muscles, including the 'invisible' ones (deep muscles or those too small to be of interest). The bodybuilder mistake is illustrated by the tragic story of champion Ronnie Coleman. By lifting titanic weights and ignoring his body's signals, he destroyed himself: neck injuries, hip replacements, fusions of each of his vertebrae, and ended up, at the age of 50, crippled in a wheelchair.

If you're into bodybuilding, don't make the same mistake. Go for long sets (20/25 reps) and stop the exercise as soon as your form deteriorates. You'll get just as good results as those who lift heavier, but without the risk of injury. Since I decided to devote a third of my training to therapeutic exercises ('rehab is training'), my body has never been so resilient: no more back pain, my knees support me when I run, and my shoulders have become super stable.

*If you're over forty and your only aim is to put on muscle mass, I'd advise you, instead of spreading yourself too thin, to choose four basic exercises for your 'intensity' session this week, such as pull-ups, dips, squats, or deadlifts, taking long breaks between sets to recover as fully as possible, with a maximum of three sets per exercise, in pyramid mode (10-8-6). For the other three sessions, I suggest you do high volume (long and numerous sets, without going to failure, but always limiting the number of exercises to four or five). In short, 20% intensity (one session) and 80% high volume (four sessions).*

## The Role of Tendons in Chinese Martial Arts

Tendons are a recurring theme in martial arts and Chinese medicine. There are musculotendinous meridians made up alternately of tendons and muscles. There are over 4,000 tendons in the human body, far more than the 650 muscles listed.

The transformation of muscles and tendons is addressed in the Yi Jin Jing, reduced in its modern version to simple stretching. It is also found in Ji Ben Gong, preparatory exercises for kung fu, and at a more advanced level in the practice of the 'iron shirt', the aim of which is to make the body virtually invulnerable in combat. The latter includes both static exercises (tree stance, for example) and dynamic ones (twisting or whipping movements). The aim is to be able to 'take' attacks and deliver devastating blows.

Bruce Lee, comparing a karate and kung fu punch, said that the former is like a blow from an iron bar, while the latter resembles a steel ball attached to a chain.

Joint-strengthening routines also exist in White Crane boxing and in Okinawan Japanese martial arts, notably Kyokushin-style karate. These schools also use the same accessories: rings on the arms, weighted soles, jars filled with sand to be lifted with the fingers, etc., which suggests that they have a common origin.

An unusual practice that originated in the iron shirt consists of flogging one's bones with a bundle of bamboo or metal rods. I wouldn't recommend trying the second method, which is reserved for martial arts practitioners, but according to Qi gong experts, the bamboo whip detaches dead particles from the bones, encouraging their regeneration and increasing bone density by stimulating marrow production. Experimental truth or belief, this practice is an excellent proprioceptive means of stimulating dormant areas and getting the blood flowing.

In addition to Ji Ben Jong and iron shirt training, other practices such as Zhang Zhuang (tree posture), Ba Duan Jin (a gymnastic routine designed for soldiers to enhance overall resilience), as well as Qi Gong (energy control) and Nei Gong (internal work), all contribute to protecting the joints by developing non-muscular strength. Let's not forget Tai Chi Chuan, which aims to develop hydraulic force (Fa Jin) by mobilizing bodily fluids through fascial activation, somewhat akin to squeezing the bulb of a sprayer. Fascia, whose activity is normally involuntary, can nevertheless be mobilized through a special training based among other things on reverse breathing (drawing in the belly on inhalation and expanding it on exhalation). However, these techniques are beyond the scope of this book.

*Muscle-tendon meridians in the Chinese tradition*
*These meridians are different from the ones used in acupuncture*

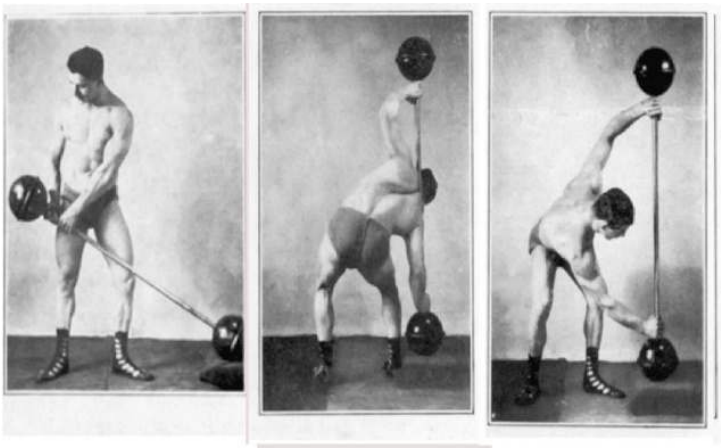
## Tendon Development in the West

Up until the Middle Ages, fierce sword and saber battles raged. Only a handful of contemporary athletes would be capable of swinging a heavy sword for more than a few minutes, due to the tetanizing effect of lactates (perform continuous arm circles with a 2 kg dumbbell to get an idea). Quite probably It's because the warriors of the past had developed the strength of their tendons that they were able to continue fighting for hours on end. Indeed, proper tendon development prevents muscle congestion and fatigue. How can non-contractile collagen cords increase strength tenfold? If you look at a suspension bridge, you can see that it is only held up by the tension of the cables, according to the principle of tensegrity. Similarly, if you try to twist a towel to wring it out, it's easy at first, but then you encounter increasing resistance. If that towel were a big bundle of elastic (a bungee jump rope) it would whip like a whip when released. Creating torque through the tendons stiffens the joints and multiplies the force. That's why we recommend screwing your feet into the ground when deadlifting. This torsion leads, depending on its direction, to extension or flexion, as you can see with a swimming noodle: if you twist it, it will automatically bend, but if you twist it the other way, it will straighten.

## Tendon Strengthening was Known to the Ancient Strongmen

The strength of the mustachioed Hercules of the 'Belle Époque' surpassed that of our doped-up bodybuilders. One of the most famous was Eugène Sandow, who could lift two people over his head with one arm and perform pull-ups with just one finger. At the age of 66, he was still taking part in strength events. Paradoxically, he was a fan of light training in long sets of 30 to 120 reps, a technique he considered ideal for developing the muscle-tendon connection. His technique was based on metabolic stress (volume), one of the three main ways of stimulating muscular hypertrophy, along with metabolic tension (the intensity of the load) and eccentric work (which breaks down the muscle fiber so that it can be rebuilt stronger). Other 'old school' strongmen attribute their performance to tendon training, George Jowett, and George Hackenschmidt for example.

What is striking about the training of the old strongmen is the number of crazy, even unnecessarily dangerous, exercises they were fond of. Many of them, coming from the circus, had developed extraordinary physical qualities, which explains why they could do almost anything with their bodies. Imitating them with our 21st century bodies would be a very bad idea. I've often wondered whether they were unaware of the risks involved or whether our bodies have become considerably more fragile since then? I'd lean towards the second hypothesis: clearly, the human body has not evolved to become more resilient.



*One of the many 'old school' exercises, it doesn't seem to do much good except herniate a disc. Being able to do it without injury demonstrates an exceptional level of joint stability.*

No one can escape sarcopenia (muscle loss) with age, since after the age of thirty we lose one percent of the hormone essential for muscle synthesis, testosterone, every year. What's more, it's impossible to have a lean, chocolate abs bodybuilder's look after the age of 60 without doping, whatever the 'influencers' on Instagram may say, so many of them are doped. Obviously, doping covers a wide spectrum, from pro bodybuilders loaded up like race horses to those who adopt a minimalist approach.

If you want to maintain functional strength for a long time, it's best to focus on the tendons, which are little affected by the drop in hormones. Without being visually impressive, you'll develop considerable strength, and you won't have to train harder and harder every year to maintain your muscle mass. In classic bodybuilding, if you don't go forwards, you go backwards, and if 10 weeks' training produces 8% muscle hypertrophy, stopping for just two weeks will cause you to lose about the same amount. Manual workers and former athletes retain impressive strength well into old age, described by the Americans as 'old man strength'.

This "old man's strength" is reflected, among other things, in his steely grip. At the age of 80, former American wrestler Danny Hodge is still capable of crushing an apple with one hand. Besides, serious studies have established a link between grip and life expectancy (16).

To illustrate the difference between muscular strength and tendon strength, we need look no further than arm-wrestling expert Devon Larratt's domination of Icelandic strongman Thor Bjornsson, who has an impressive arm circumference of 21". Logically, the Canadian should never have beaten the colossus, because muscular strength is linked to fiber diameter (in this case, arm circumference). Of course, the recruitment of motor units (nerve impulses) also has to be considered, but that's not the difference, as they are both athletes. The explanation lies in the numerous isometric exercises that arm-wrestling experts perform to strengthen their joints and increase the strength of their tendons.

## Scientific Protocols To Stimulate Tissue Growth

| REHABILITATION OR GROWTH | STIMULATION | OPTIMAL INTERVAL |
|---|---|---|
| CARTILAGE | 20 to 1000 RM | 100 to 1000 RM |
| TENDON | 14 to 1000 RM | 15 to 500 RM |
| HYPERTROPHY | 1 to 20 RM | 5 to 10 RM |
| STRENGTH | 1 to 8 RM | 1 to 5 RM |

*Table inspired by Steven Low's book, "overcoming tendonitis" (L1), which cites research by the University of Maryland. "Hypertrophy" here means muscle growth.*

*Strength Development*
One to five repetitions at 80/90% intensity of 1RM.
1RM=maximum resistance you can do in one go, in other words your max for a single repetition) x 5 sets

*Tendons (Prevention or Rehabilitation)*
Series of 100 to 300 repetitions with an intensity varying between 40 and 60% of 1RM
Repeated three times x 3 sets.

*Muscular Hypertrophy*
8 to 12 repetitions at 70/80% of 1RM x 4 sets

*Cartilage*
Over a thousand repetitions with an intensity of 20% of 1RM

Example Of Giant Series Cartilage Exercises

- Knees and hips: cycling or rowing, jumping on a trampoline, squats off the body using a harness connected to elastic bands or a counterweight, pool exercises (jumping, kicking, etc.).

- Shoulders and elbow: "arm cycle" machine used in gyms, light Indian clubs (500gr), work with low-resistance elastics.

## Focus on Tendons and Ligaments

Ligaments and tendons are nothing more or less than strips of connective tissue (the body's packaging tissue). The main difference is that ligaments hold bones together and need to be very rigid, whereas tendons link bones and muscles and need to combine two opposing qualities, like a chimera: rigidity on the bone side and compliance on the muscle side.

However, the distinction between tendons and ligaments is artificial: the subscapularis tendon, for example, becomes the transverse humeral ligament. Wrongly described as passive tissues, tendons and ligaments are in fact quite active since they always have a basic tone. Connective tissue is made up of collagen fibers, the most common protein in the body, which can be found just about everywhere: tendons, ligaments, cartilage and even bones, teeth, and skin.

The fibers of healthy tendons run parallel like the threads of a rope, whereas ligaments, which have to withstand multidirectional stresses, have their fibers entangled like the weft of a fabric. Tendons are generally longer than ligaments, and animals in particular have very long tendons, which explains their extraordinary elasticity. A cat, for example, can jump six times its own length. What's interesting is that collagen fibrils can be normal (helical) or 'misfolded'. These abnormal fibrils must be destroyed either by the endoplasmic reticulum or by autophagy (19). If this is not the case, the tendon will be weakened.

Tendon injuries are common (30-50% of sports injuries), and it is preferable to break a bone than to rupture a tendon, even partially, because the bone will rebuild faster and better, being 'metabolically' more active. It takes two months before you notice any structural change in the tendon, whereas muscles change after just eight days' training and a fracture consolidates in six weeks. Serious tendon injuries take four months, but discomfort can persist for a year or more.

Powerlifters spend three times as much training their tendons as their muscles, which makes sense, because a tendon rupture ends a sporting career, as you will never recover 100% of your pre-injury capacity. Most of the professional bodybuilders who had to stop their careers at the height of their glory did so because of tendon injuries (Dorian Yates and Ryan Crowley for example). For an athlete, a drop in performance of just a few percent makes all the difference between victory and failure.

If you feel sore the day after intense training, it's because your body repairs connective tissue before creating muscle, which proves its sense of priorities: a little less muscle is not as serious as chronic injury. It only takes an 8% stretch to tear a tendon (6% for a ligament) and it will take longer to heal than a muscle (4 months minimum).
But it's only by multiplying this time by two that you can hope to train again at your initial level, because you'll have to start again from a lower level.

If tendon injuries are frequent in top-level sport, it's the result of a long degenerative process: healthy tendons never rupture (10), because collagen is extremely resistant. The exception (which proves the rule) is doped athletes whose muscular strength surpasses the resistance of their tendons and who can tear their Achilles tendon simply by climbing a flight of stairs (steroids only have an effect on the muscle), but apart from this particular case when a tendon breaks it's because it's degenerated, otherwise it resists almost everything.

## The Real Disease of the Century: Joint Degeneration

It's a strange phenomenon when biological tissues degenerate at an accelerated rate, without any initial trauma, giving rise to pain at random. As we age, the amount of collagen and cartilage diminishes, as shown on X-rays by dark areas, but this phenomenon sometimes affects young adults prematurely.

In my first book "How I overcame back pain" (not yet available in English), I quote the findings of a study revealing that among young people aged between 20 and 22 who have never had back pain, 48% (at least) have a degenerated disc and 25% a bulging disc. The prevalence of Achilles tendinopthy in the general population is around 6% in sedentary people and 60% in athletes! (27)

There is no radical solution to these protean degenerations: osteoarthritis, calcification, inflammatory processes, apart from stem cell therapy, which is still banned in many countries for ethical reasons because it uses umbilical cord cells whose origin is sometimes difficult to trace.

The minimum you can do is to stay well hydrated, ensure your body has a sufficient supply of collagen, vitamins, and minerals, and avoid overly intense or unusual exertion. There are in fact two solutions to aging with good joints: the pink pill of remaining sedentary all your life and the blue pill of leading an active life, while developing your body's resilience. I invite you, as you may have guessed, to choose the second option.

LOAD > CAPACITY = INJURY
LOAD < CAPACITY = REHABILITATION
CAPACITY >> LOAD = PREVENTION

*A load in excess of the capacity is likely to cause injury. By capacity, I mean the resistance of the tissues (muscle, tendons, ligaments, etc.).*

*In rehabilitation, we work with loads that are lower than this capacity, whereas in prevention we have to develop a capacity that is much higher than the constraints of the sport being practiced.*

*A bit like testing a bridge before use by loading it with dozens of sixteen-ton lorries, which never happens afterwards.*

## Preventable Causes of Joint Pain In Sedentary People

### Not Moving Enough

Moving like a six-year-old, i.e. changing posture frequently, is ideal for preventing joint problems. This isn't always possible at work, which is why I recommend that you take up a sport that involves creativity and teaches you new ways of moving, such as dance, climbing or jiu-jitsu.

The worst thing that can happen to you as a result of chronic pain is to get 'kinesiophobia', i.e. the fear of moving. Staying active, according to your ability at the time, and avoiding painful movements, has never aggravated existing pain - quite the contrary.

I would add that limiting yourself to low-impact sports, in the belief that you are taking it easy, is not the best strategy, as it predisposes you to osteoporosis. In fact, studies show that heavy lifting and impact sports (jumps, etc.) strengthen the bones. It's all a question of balance: competition wears out joints prematurely, but inactivity wears them out too. If you have moderate joint pain, reduce the intensity of your sport first, and observe how your body reacts to it, but don't stop it altogether.

People who are allergic to sport keep their joints in perfect health right up to the grave, but when faced with unusual exertion their chances of injury are increased tenfold, not to mention the fact that sport is an essential factor in well-being and cardiovascular health.

Exercise increases bone density. The humerus of a baseball player's throwing arm, almost twice as thick as that of the other arm. The closer you get to the elbow, the thicker it is.

## Two Common Causes Of Injury

Speed, ubiquitous in modern life, is a frequent but easily avoidable cause of injury. Admittedly, it's rare that five minutes gained, or lost, are decisive in your future, whereas snatching your suitcase off the floor or tumbling down a flight of stairs exposes you to injuries that can become chronic. So, it's up to you, but personally I prefer to 'hasten along slowly' like the tortoise in La Fontaine's fable, rather than exert myself without at least a minimalist warming-up, and particularly efforts soon after waking up should be avoided. There are injuries that we accept as part of the risks associated with a sport or profession, but it's better to do everything we can to avoid the others. A second observation is that injury occurs when muscles, ligaments and tendons, are unable to absorb and disperse the amount of force applied to them. By cultivating your mobility and strength, getting regular massages, or massaging yourself (foam rollers, etc.), you can largely neutralize the risk of injury.

## Prolonged Joint Compression

One of my patients limped for months after falling asleep with one leg dangling out of bed. There's also the annoying habit of hooking your chair with your feet or sitting on the floor with your legs in a 'W' (Photo). No posture is bad if you vary it often, but the compressions, twists and prolonged stretching of ligaments are irreparable, because ligaments are not elastic

## Overhead Activities

Keeping your arms above your shoulders for a long time, with a weight in your hands (trimming a hedge or painting a ceiling, for example), without being used to it, often proves catastrophic, particularly for the supraspinatus tendon, and the higher the arm, the greater the risk of conflict.

Some people will tell you that all these postures are OK, that you just need to prepare for them, and they're not wrong, but how long will it take and how far will the body adapt? How can you know your limits without already having hurt yourself? When I was twenty, I could lift two hundred pounds with a completely rounded back, without any pain. Today, if I did the same thing, I'd end up in hospital. Everything in life is OK until it's not OK any more.

## Falls

Among older people, every fall carries the risk of injury, notably leading to hip fracture. However, falling is a situation for which one should be prepared, as it is bound to happen. Never experiencing a fall leads to apprehension and excessive tension in the body, which increases the severity of impact upon hitting the ground. Learning to quickly lower one's center of gravity, to exhale during a fall, to execute a roll, to get down and rise from the ground without using hands, and to improve mobility are all precautions to master the art of falling

## Main Causes Of Non-Contact Joint Pain In Athletes

### Falls and Jumps on Hard Surfaces

Jump landings and falls are the most common sports injuries. Landing with the foot off-center in relation to the knee is classic, but even when carried out correctly, too many jumps, such as the 'box jump' series in CrossFit, can undermine the Achilles tendon, because the angle of the ankle is often less than 90° during the impulsion and especially during the landing, which stresses the tendon and crushes it against the calcaneus.

In the USA, basketball is one of the most common sports in terms of injuries (ankles, backs, knees), mainly due to landing jumps. Significant progress has been made in the technology of sports shoe soles, but the fact remains that landing on hard surfaces takes a heavy toll on the joints.

### Sports with Limited Range of Movement

Sports based on single, repetitive movements are likely to cause overload pathologies. A professional baseball pitcher has only one movement to perform and, even if he subtly varies his gesture, it will always involve the same 'tissues'. His career is therefore likely to be shorter than that of a surfer or even a climber, who never performs a route in exactly the same way and uses his body in an infinite variety of angles. To last, introduce variety into your motor patterns and practice a complementary sport off-load (cycling or swimming), if your main sport is weight- bearing. This will give your joints a 'breather' and develop the muscles that are antagonistic to those used in your main sport.

### Overhead Sports

Frequent raising of the arms above the head can lead to shoulder conflicts, if the scapula has difficulty rotating externally (elevation and rotation). Lowering your arms to the point where they are straight during pull-ups can also cause this type of pathology.

*To prevent these problems, develop scapular mobility by learning to lift the arm with the 'armpits' rather than using the upper trapezius. This will avoid reducing the subacromial space and protect the shoulder tendons. An excellent motor reprogramming exercise is to slowly raise one arm above your head, activating the armpit area but releasing the upper trapezius. To do this, feel the area between the neck and shoulder to check that the trapezius remains relaxed throughout the movement. This exercise needs to be practiced regularly (5 minutes a day for a month) so that it becomes ingrained in your motor memory (See p: 78).*

### Sports Based on Rapid Circles

Arm circles are found in many sports such as boxing, swimming, athletics, and tennis. Leg circles are also found in sports such as Taekwondo. With speed, these large circles can throw the joint off-center and cause friction between the tendons and bones if the rotator cuff is not balanced. If you practice these sports without striving for performance and if you have good mobility, the risks will be negligible, unlike, for example, a butterfly swimmer. Studies have shown that neck circumductions, long used in sports warm-ups, promote cervical osteoarthritis.

### Non-Functional Exercises

The tendency is to say that there are no bad exercises, only poorly executed ones, but let's look at some concrete examples. Statistically, the bench press is the most injury-causing bodybuilding exercise in the gym, just ahead of the deadlift. Firstly, pushing a heavy load, lying on your back, is of no functional use in real life and the bench prevents abduction of the shoulder blades during the descent of the bar, thus encouraging rubbing of the supraspinatus against the acromion and decentering of the humeral head. In addition, the mechanical disadvantage is greatest when the shoulders are in a vulnerable position, i.e. when the bar touches the chest (horizontal extension and internal rotation), making this a very risky exercise for the shoulder. If you do a lot of functional exercises, you can allow yourself a small dose of non-functional exercises, but as a general rule it's best to avoid them. Weighted waistcoat push-ups are a good alternative to bench presses.

### Ignoring the Stages of Progress

Avoid bodybuilding programs where loads are constantly increased without any adaptation/plateau period. According to the principle of Specific Adaptation to Imposed Demand (SAID), when the objective is reached, in terms of repetitions and sets, it is advisable to increase the load by 2.5 to 5%. However, by progressing in this way over a long period of time, there comes a time when the tendons will eventually give out, because they strengthen more slowly than the muscles. You'll eventually have to take a break because your joints won't be able to keep up. You should never try to force your muscles to adapt. If you don't allow for intervals in your training program to give your tendons time to catch up, injury is almost guaranteed. Christopher Sommer, Ido Portal's mentor, trains his athletes with the same weight for 8 to 12 weeks and only increases the load when the movement becomes too easy. Following this principle reduces the risk of injury, as two months gives the tendons and soft tissues time to catch up. Tendons and ligaments also need you to vary the number of repetitions and the speed at which you do them, because some types of tendons strengthen at high volume, while for others it's the opposite.

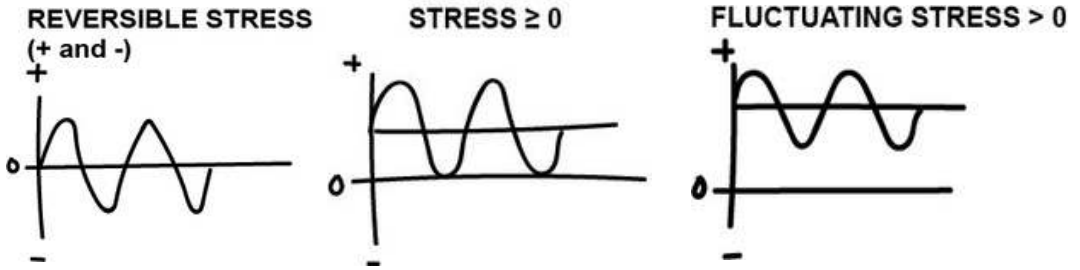
The ideal is to alternate heavy, slow training with fast, high-volume training (sets of 20 to 30 repetitions).

### In Pursuit of the One More 'Rep'

Blinded by the motto of "no pain, no gain", we fall into the trap of overtraining. It's fun to assess your limits by going to muscular failure, until you can't move the load a millimeter, but the key to progress is to be regular in your sessions and avoid overtraining. Attempting to push your limits with each set is only productive for those who benefit from accelerated recovery: young people with excellent genetics or doped-up athletes. The idea of always going to the extreme limit of one's capacities is counterproductive, and Pavel Tsatsouline has shown the error of this (30) by demonstrating that it fatigues the central nervous system, compromises recovery, and shortens sporting longevity. The extra repetitions, hard earned, will paradoxically make you perform worse in the next session. It's better to finish your set with one spare repetition, and only add weight when your body demands it, because the body strengthens, even if the load remains the same for several weeks. Of course, at some point, the exercise will become too easy (your body will tell you) and you'll need to add weight, but systematically going for failure by increasing the load at each session is the wrong strategy.

### The "Cyclic Sports" Trap

Cyclic activities, which contrary to what their name suggests are not limited to cycling (although cycling is one of them), are so named because they are based on a simple movement, performed tens of thousands of times. This is the case for swimming, kettlebell swinging, horse riding and also professional activities such as using a jackhammer. Other sports, which taken as a whole are non-cyclical, nevertheless include cyclical phases. Motorbike trail riding, for example, where the knees absorb the shocks of the track, producing cyclical oscillations. There are three types of cyclic stress (which can be represented by sinusoids): alternating compression and decompression causing reversible stress (e.g. cycling with strapped pedals); alternating compression and rest, such as when running (when the foot lifts off the ground the compression is canceled); and maximum and minimum compression, which is nevertheless always positive, i.e. fluctuating stress (e.g. water-skiing).



Cyclical' sports based on fluctuating stress cause focal stress, rather like a stone cutter who always hits his stone in the same place. This type of sport is by definition stressful for the targeted joint (the knee for the horse rider or the repeated lumbar rotations for the crawl swimmer). Obviously, the risks are more likely to arise in the case of intensive practice and not among weekend sportsmen and women.

### Explosive Sports

Sports involving sudden acceleration and deceleration place greater stress on the tendons. If we compare a clean and jerk to a squat, the former, because of its explosiveness and speed, will naturally be more stressful than the latter. Does this mean that these movements should be avoided? Not if the body is prepared for them, but in the rehabilitation phase or when resuming an activity, it's better to err on the side of caution and favor slow movements without bouncing.

### Why We Never Warm Up Enough

*The older you are (or the colder it is outside), the longer you should warm up. This is important not only for the muscles, but also for the tendons, which need to be warm to become supple.*

Knee and elbow support have no other effect than to keep the joint warm. In general, I recommend warming up the area under the joint that is being used for sport (calves, before going for a run, forearms, before using the elbow, biceps, and triceps, before doing shoulder exercises), as this will have a knock-on effect.

Whether you're doing sports or weight training, there's a simple way to gently prepare your tendons for exertion. After warming up with 10 minutes of light cardio (exercise bike), do a preliminary series of ten slow repetitions with low resistance (elastics, for example) in full amplitude (joint locking and maximum flexion). Your tendons will then be ready for training.

### The Danger of Stretching

Stretching before sport can be catastrophic. I've had a painful experience of this by doing yoga-type stretches of the spine before doing kettlebell swings, a very bad idea that gave me disc injury. If I stretch my quadriceps before running, I can easily rupture my cruciate ligament because its medial bundle stabilizes the knee, and the same goes for the hamstrings, which prevent the anterior drawer of the tibia

I also recommend, as a matter of principle, leaving a day's rest between two intense stretches of the same muscle to give the micro-scars produced by the stretch time to repair themselves.

## Types of Mechanical Stress Applied to Tendons

Tension
Concentrate and then release energy (jumps) or redirect forces: tennis player suddenly changing the direction of his run. Tension is produced by the muscle.

Compression
Pressing against a bone. Example: the quadriceps tendon pressed against the kneecap when squatting).

Stretching + Compression
Bouncing: during a jump, the Achilles tendon is simultaneously stretched and crushed against the calcaneus. This is maximum stress for the tendons.

Rubbing
Cycling causes friction in the Achilles tendon.

## Tendon injury: Managing Pain in Rehabilitation

An injured tendon will not necessarily manifest itself as pain, especially in the early stages (see iceberg diagram below), but pain should always be listened because tendon pain is always the result of damage.

In all cases, physical activity should be resumed as soon as possible to reduce the pain sensitivity threshold and remodel the degenerated area as soon as possible.

Note that when pain appears during the rehabilitation process, you should not systematically reduce the intensity of the exercises, but rather increase their frequency, which gives the tendon a chance to get used to the stress, because if the stimulation is too far apart in time, adaptation will be more difficult.

Start with isometrics and then reduced amplitude but do lots of repetitions to progress to medium amplitude and then full amplitude as you heal.

If you don't pull on the tendon it won't heal, to get a significant pull you need also a strong muscle and work at about 70% of your 1RM. You have to progress to this level progressively once the acute stage is over.

The rule of thumb to know how far you can go is "does my tendon hurt?", if so scale back ; otherwise keep going.

Tendon strengthening is influenced more by the rate/speed of loading than by the load itself. In other words, jumping is more efficient than leg extensions for the development of the patellar tendon.

Experiencing pain during a rehabilitation exercise, as long as it does not exceed 2-3 on a scale of 10, is okay.

**How do you prevent injuries?**

Every day, when you get up, spend 10 minutes preparing your joints for the day's challenges by 'lubricating' them. Whether you're lifting your dog off the ground or sprinting to catch the bus, you're ten times less likely to get injured if your joints have already been woken up and the synovial fluid is no longer stagnant. This can be done with light movements: arm circles, knee circles, elbow rotations, hip flexion-extension, circles, etc. A fun way to warm up is to drop a stick balanced on its tip and catch it before it hits the ground. The randomness of the fall will force you to be reactive and move in spontaneous patterns. This principle also applies to sports: make sure you warm up before playing, especially in winter. In sub-zero temperatures, it can take as little as a minute of immobility to cool down. Although I'd warmed up carefully, I pulled my hamstring playing tennis after waiting5 minutes in the cold for a class to open up. Taking time off is another frequent cause of injury. If you've stopped doing a sport for more than ten days, I recommend that you start again slowly,even if you feel capable of resuming it at 100%.

*A tip: when you start a new exercise that you're not used to, do it at 80% of maximum intensity and wait two days before going up to 100%. Tendon pains only appear after 24 hours and sometimes even 48 hours, so you'll have time to see whether the exercise is good for you or not. Abrupt progressions are the main cause of sports injuries, so avoid bad trainers who, from one session to the next, double your workload, supposedly to push you beyond your limits. Good progress should be imperceptible.*

**Can Tendons, Ligaments and Cartilage Be Strengthened in the Same Way as Muscles?**

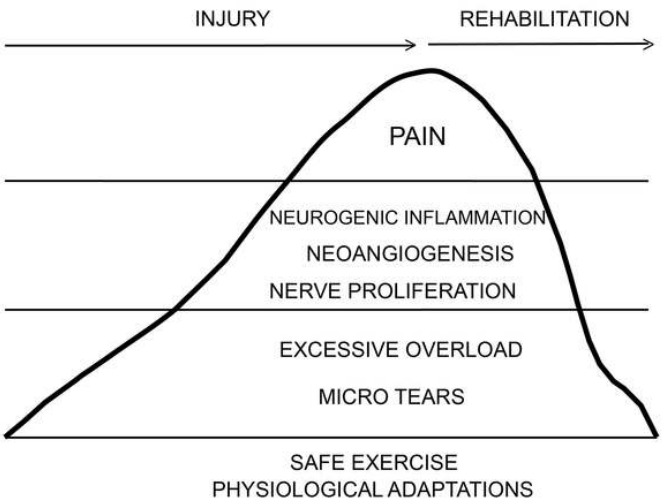
The short answer is yes! Studies have shown that footballers have thicker than average cruciate ligaments, due to frequent changes in direction. Similarly, in rock climbers, the diameter of the tendons in their wrists increases by 62% to 76%. Their fingers become thicker, even thicker than those of a Powerlifter, because climbers are constantly using their hands.

Another study has shown that Chinese weightlifters have cruciate ligaments that are twice as thick as the average. In order to thicken, connective tissue needs a high volume of work. Conversely, if you stop all activity, the tendons will reduce in volume, just as muscles do, but much more slowly. Be careful, though, because injured tendons also swell, which obviously does not mean that they are stronger, but that they are inflamed - this is called tenosynovitis.

It is also possible to build fibrocartilage with specific training, which, although it does not have exactly the same properties as the original cartilage, will protect the joint when the latter is worn.

## The Stages of Tendonitis

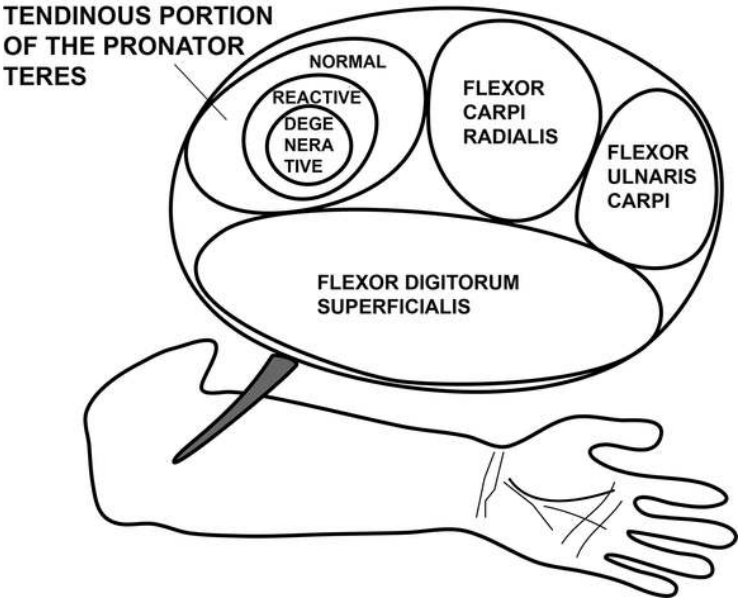
As tendon diseases are not inflammatory, the word "tendonitis" has been replaced by "tendinopathy". Note that the inflammation is present for the first three to five days but, being neurogenic, it does not last. 'Neurogenic' meaning that it is not caused by an immune response, but by the afferent (sensory) neurons, like a migraine, for example. Unlike muscle injuries, which heal quickly on their own, the absence of inflammation slows down healing. The infuriating thing about tendinopathy is its "Loch Ness" effect: just when you think you've got rid of it, it resurfaces, after warming up too quickly, increasing your workload or returning to sport. Tendinopathy is an overload pathology that appears when mechanical stress exceeds the tissue's capacity to adapt. This is when the reactive phase begins (18). During this phase, if the stresses are reduced, the tendon will heal without any after-effects. The trap is that this onset is insidious, as it is asymptomatic, with pain appearing late, as you can see in the diagram below. Note also that you need to be patient before resuming full activity, as the tendon remains weakened even after the pain has stopped.




The Iceberg model of tendinopathy progression (13)

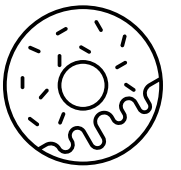
If we fail to adapt the mechanical stresses, we fall into stage two: partial repair. As the lesions multiply, the body will no longer be able to heal them all. If this stage persists, the third stage is reached: irreversible deterioration, which is like scratching your scabs without giving them time to dry, resulting in scars or even ruptures. By this stage, the symptoms have been present for more than three months and rest no longer relieves the pain, which is present from the moment you wake up.

At this stage, recovery is still possible, but only partial. Tendinopathy affects only part of the tendon (see diagrams below) and can be treated at all stages with physiotherapy, except in the case of a total tear requiring surgery.




*Tendonitis is manifested by the presence of islands of more or less diseased tissue. It is difficult to target these areas with exercise, as the load tends to be diverted towards healthy tissue (10) (26). The reactive area can heal MUCH faster than the degenerative. Often a reactive tendon ("reactive" due to an overload) become degenerative because one do not let it rest for few days. Degenerative tendons take much longer to heal.*

One principle of tendons' rehabilitation is to "treat the donut, not the hole", because the degenerated area will never heal completely (that what we thought until recently), but the healthy part can and should be strengthened. As the tendon is a robust structure, this is often enough to enable you to return to an active, pain-free life. Tendonitis is manifested by the presence of islands of more or less diseased tissue. It is difficult to heal these areas with exercise, as the load tends to be diverted towards healthy tissue (10) (26). For this you should perform long isometric as I'll explain later.



*Injured tendon looks like a donut, with the damaged tissue forming a hole*

*Funfact: the weightlifters' cruciate ligaments are twice as large as those of the control group for the anterior cruciate ligament and a third larger for the posterior cruciate ligament. (5)*

**Back on Top After Injury**

If you're an athlete unable to resume your sport because of an injury, there are four tips to help you recover more quickly (20).

-*The first* is to practice visualizing the movements of your sport. This prevents motor patterns from deteriorating.

-*The second* is to adapt it to your current disability. For example, a footballer with an injured leg can work on his heading while sitting and waiting or train the other leg using crutches.

-*The third* is contralateral work, training your uninjured arm to transfer part of its strength to your injured arm.

-Finally, science also claims that the simple act of watching sport can activate the brain and spinal cord.

**Tendonitis and Medication**

Certain classes of antibiotics pose a risk to tendons (31). Fluoroquinolones, for example, and especially levofloxacin, are prescribed for certain ENT conditions.

There are also statin- and corticosteroid-based drugs, which can be disastrous if taken on their own or in combination (quinolones plus corticosteroids).

# PART TWO: PRACTICE

## THE TENDONS

### TENDONITIS PREVENTION STRATEGIES

#### Light, Fast, Long with Bands

In adults, tendons are poorly vascularized and feed almost exclusively on synovial fluid. To increase the circulation of this fluid, we need to move more to 'pump' more fluid into the joint. Regular exercise also vascularizes the tendon. This involves moving the tendon over a long period of time by performing thousands of repetitions of a low-intensity exercise. The traditional or elliptical bike, the rowing machine and the "arm cycle" machine are ideal for this. Long sets of fast movements with elastic bands (100 to 300 repetitions) are one of the tendons- strengthening protocols of the legendary Westside Barbell powerlifting club (14). As the destruction of muscle fibers occurs mainly during the eccentric phase, we try to shorten this phase, using elastic bands to neutralize the production of lactic acid, which makes it possible to perform very long sets without muscle congestion and to nourish the soft tissues by increasing the blood and synovial supply. If your elbow hurts, for example, hang a rubber band over your head and do a hundred quick triceps extensions. The key point is to relax the arm during the eccentric phase and let the elastic do its work, so as to avoid straining the muscle fibers.

#### Vary The Speed, the Weight, and the Number of Repetitions

Certain types of tendons are stimulated by slow speeds and heavy loads, while for others it's the opposite. Vary the volume of work (number of repetitions and sets), to cover the whole spectrum and ensure maximum safety.

#### Functional Range Conditioning

Functional Range Conditioning is a joint strengthening protocol devised by American kinesiologist Andreo Spina. Joints are vulnerable at the end or beginning of their range of motion, so why not strengthen the muscles during maximum lengthening or shortening so that they have the strength to protect the joint during these high-risk ranges? Three techniques are used: CARS (controlled joint rotations, a kind of maintenance mobilization), PAILS: progressive isometric angular loading (the equivalent of the famous contract release) and RAILS: regressive isometric angular loading. In concrete terms, this involves a passive stretch lasting 30 seconds, followed by an isometric contraction in the opposite direction to the stretch (20 seconds) and an active stretch by contraction of the antagonist (20 seconds), the last two phases being repeated three times. His method takes advantage of the stretch reflex. It is widely used by physiotherapists and top-level coaches.

## Train your Mobility to Say Goodbye to Joint Issues

Mobility takes precedence over everything else: you can't be strong or have good motor control over an amplitude to which you simply don't have access. Mobility goes beyond flexibility since it implies muscular control over the entire joint amplitude. When we increase the segmental mobility of a joint, i.e. its ability to move independently of the others (without compensation), we introduce a new degree of freedom of movement, which improves bodily motor control. The theory of degrees of movement comes from Nicolaï Bernstein, a Russian neurophysiologist. Berstein was interested in the movements of a blacksmith striking an anvil with his hammer. He observed that the blows, which we would have expected to be identical, showed subtle variations that gave each of them a unique signature. Immobilizing a joint means losing a degree of freedom, which greatly reduces the variety of possible movements. Between the trunk and the hammer are the shoulder, the elbow, the wrist, plus the carpal, metacarpal and finger joints. This represents, analogously, a padlock with six knobs (each, arbitrarily, with 10 digits). If I immobilize the wrist with a band, I lose one knob, but in terms of combinations I lose 10 exponent 6, i.e. 1M-100000 = 900000 possibilities, hence the importance of developing the mobility of each joint to avoid impoverishing movements, which would result in accelerated wear and tear on the body. Stiffness can occur for neurological reasons (i.e. the whole muscle is hard to palpate) or for fibrosis-type tissue reasons (i.e. localized stiffness: muscle cords, for example), and the treatment to be applied differs in the two cases. In the first case, it may be useful to perform isometric contractions at the end range (contracted-released type) or dynamic stretching; in the second, self-massage with Lacrosse Ball, foam roller, Active Release Technique, loaded or ballistic stretching, which will help to reduce local fibrosis.

## Short Training Sessions followed by Long Rest Periods

Tendons, ligaments, and bones are ideally strengthened by short, high-intensity training sessions, but not to the point of complete failure, followed by long periods of rest. For an explanation, see the video by physiology professor Keith Baar, one of the world's leading tendon specialists (available on YouTube) entitled "Physical training, performance and injury prevention". According to him, training with heavy loads for 5-10 minutes is ideal for stimulating collagen growth.

## Dynamic Stretching

Dynamic stretching, which is best used as a warm-up, consists of reaching the stretching position at the end of a movement, without lingering, and then releasing the tension (back and forth movements). Unlike ballistic stretching (see below), it never exceeds the limits of passive flexibility and allows muscle fibers to be relaxed without risk of injury. It is an excellent method, especially for neurological stiffness (excess tension in the muscles).

### Explosive isometrics

Explosive isometrics is an advanced technique consisting of rapidly pushing or pulling (with increasing force) against an immovable object (wall, straps attached to fixed points, door frame for shoulder press etc.). This type of training, which is useful in explosive sports (rugby, etc.) to increase tendon rigidity, must of course be practiced with caution and a methodical progression to avoid injury. These contractions must be maximal and short (4 to 5 seconds) followed by a 5 s rest and then performing 4 Reps by exercise. This is the training that Bruce Lee used to do to gain strength without muscular bulk. *Goal : tendon rigidity*

### Partial Repetitions

Working at a third or even a quarter of full amplitude (the first ten to fifteen or last centimeters depending on whether it's a pull or a push) eliminates the most stressful part for the joints and targets the bones and the type of tendons that only get stronger with very heavy loads.
*Goall: strengthening of bones and tendons.*

*The rack pull above the knees is a partial-amplitude exercise that strengthens the back while minimizing the risk of injury (the trunk doesn't bend more than 45 degrees).. Given the reduced amplitude, it should be performed slowly to maximize the duration of the tension. You can also use this technique on benchpress, legpress, shoulder press machine and the smith machine. It is less suitable in pulling exercises., but you can still use this technique for instance in the Dorian Yates rack pull. Of course, it's appropriate to apply this technique within the range where the muscle is strongest*

In the United States, electronic machines "Osteostrong") have been specially designed to strengthen bones by applying colossal compressive forces in the diaphyseal axis of the bone (its lenght). For the record, although bones are much less dense than concrete, they are nevertheless four times stronger: a one $in^3$ cube of bone  can bear a load of 19,000 lb.!

## Advanced Special Techniques

### Ballistic Stretching: Wushu Protocol

The advantage of ballistic stretching, popularized by Wushu, is that it quickly brings the muscles into a position of maximum stretch. This can be useful in preventing muscle tears caused by the stretch reflex in fast, wide-ranging movements, such as the high kicks of martial arts, hurdles in athletism, etc. However, you need to know how to dose this technique correctly to avoid injury, so It's important that you adopt a gradual progression. If you're training for high kicks, for example, you should use a reference point not to exceed and try to touch it with each kick. Then, aim to progress by a few millimeters in each session by moving this reference point higher.

### Loaded Stretching

Weighted stretching was popularized by fitness gurus such as Pavel Tsatsouline, Christopher Sommer, and Ido Portal. Its principle is to use weights to intensify the stretch and strengthen the muscle, returning to the initial position by the contraction of the muscle being stretched, so it's both stretching and strengthening. A famous weighted stretch is the Jefferson Curl, which involves curling the spine, one vertebra after another, while holding a weight in the hands.

The Romanian Deadlift with straight legs is also a very good functional stretching exercise for the hamstrings. Weighted stretching is recommended for injury prevention, starting light and progressing gradually. It saves a lot of time, as you no longer need to spend 1 minute or more in a posture, as you do with passive stretching, to achieve a significant effect.

The Jefferson Curl, a weighted stretch that can sometimes relieve chronic back pain, involves rolling up the vertebrae one after the other with the legs straight, starting with the cervical vertebrae. I advise using light weights (10 to 20 lb.) to avoid any risks. After all, rehabilitation is like taking medicine - it should never be risky (primum non nocere).

## TENDON REHABILITATION
### By Level of Difficulty and Stages of Rehabilitation

#### Light Stretching

It is used at the start of rehabilitation because it reduces muscle tone (and therefore pain) without the risk of aggravating the injury (unlike passive stretching). It consists of opening up the joint angle without causing discomfort and without trying to gain amplitude, by avoiding lingering too long in the stretching position.

#### Isometrics

Isometric exercise causes no tissue friction, and therefore no pain. With little stress on the joints, it is the exercise of choice in the acute phase (7). Isometric exercise normally uses heavy loads and contractions lasting 45 seconds, repeated 5 times. Another way of practicing it for tendon rehabilitation is to perform five-second contractions in a ramp (i.e., increasing the intensity), starting with the muscle shortened to the maximum and then gradually opening the joint in successive 10° increments. If pain is felt, return to the previous increment by closing the joint angle. An isometric contraction radiates about ten degrees before and after, so if your painful angle is at 90°, working at 80° will allow the 90° angle to be targeted by irradiation. As you progress in this way, there comes a time when maximum joint opening is no longer painful. The more the joint angle is open (the more the muscle is elongated), the more tension there is on the tendon, so if you're able to maintain maximum isometric tension of the biceps with the elbow very slightly bent (e.g. 160° open) without pain, that means your tendon is working again and it's time to move on to the next stage: eccentric or heavy slow resistance exercise.

The special feature of isometrics is that it allows the tendon to relax, since the two ends of the muscle do not come together, which concentrates the tension on the muscle. So doing a wall chair exercise quickly becomes torture when the leg starts to shake (which is when the tendon relaxes), even though at first the effort seems minimal. Finally, I'd add that there are two types of isometrics: one where the intensity depends on your will and goes from 0 to infinity (if I pull on a strap attached to a fixed point, the muscle contraction depends solely on the force I put into the effort), and one where the intensity is always positive but constant (staying in a plank, for example, because I can neither increase nor decrease it). In general, the first should take between 4 and 5 seconds, while the second should take between 20 and 40 seconds.

#### Lightweight, Fast, Reactive and Long Sets with Elastic Bands

See description on page 24. Start with a reduced range of motion and progress to full range of motion.

### Eccentric

Until recently, the eccentric was, along with the isometric, the technique with the most scientific validity. Now it's Heavy Slow Resistance (8). Eccentric training strengthens the elastic component of the tendon and its tolerance to pain but has no effect on the absorption or restitution of compression forces. A tendon can restore up to 97% of the force received, as can be seen during running, since once you've started, you only use 7% of the force in your calves to propel yourself.

However, eccentric training remains an effective technique. Studies have shown that it stimulates collagen production, increases tendon strength, reduces the risk of injury, and increases flexibility (for example, the eccentric part of the Romanian deadlift functionally stretches the hamstrings). The classic protocol is 3 weeks, 3-5 times a week, 3 sets of 15 repetitions a day with 5 seconds of effort (4 seconds of eccentric contraction and 1 second of concentric). Eccentrics are not always easy to do on their own, but there are tricks to minimize or even completely eliminate the concentric phase: for leg extensions on a machine, for example, you can do the concentric part with two legs and the eccentric with one. If you use an elastic band, it's even simpler, because all you have to do is relax it during the concentric phase.

### Heavy Slow Resistance Training

Heavy, slow training reduces the stiffness caused by viscoelasticity. Viscoelasticity is the phenomenon whereby collagen fibers react in unison and not individually (imagine bridges between fibers). By increasing shear at the myotendinous junction, and therefore breaking collagen inter-connections, we make the tendon less rigid and healthier. One H.S.R. protocol consists of performing 4 sets of 15 repetitions at 70-85% of 1RM (8). When you do this type of training, you should have the sensation of moving very slowly, as if through treacle. Increase the amplitude as you go along.

### Heavy, Slow Training with Relaxation Phase

This variant of the previous one consists of performing slow repetitions with a heavy load, pausing in the middle of the movement, which allows the healthy fibers of the tendon to relax so that the load is focused on the diseased fibers, as otherwise the healthy part of the tendon benefits more from the exercise as the stress is normally redirected to them.

## PERFORMANCE TECHNIQUES FOR ATHLETES ONLY

### Heavy and Fast Training

This involves lifting heavy while accelerating the load as much as possible during the movement.

### Plyometrics

Plyometrics (1), which aims to harden the tendon, is of particular interest in top-level sport, because for a non-athlete the tendon should be rigid on the bone side but compliant on the muscle side to avoid the risk of tearing. A very rigid tendon increases performance: it's easier to move a piece of furniture with a rope than with a rubber band. However, the other side of the coin is the risk of muscle tears, as the tendon doesn't stretch very much, so the muscle will have to do it for you. Plyometric training increases the connections between muscle fibers (sort of bridges between fibers). It is therefore the opposite of slow, heavy training (below). These connections increase the viscoelasticity of the muscle and tendon, i.e. their resistance to stretching over a given period of time but increase the risk of injury. It's logical: if I do an arm lock in Jiu- Jitsu and my opponent's biceps contracts abruptly when I open his elbow, either it goes through and he manages to block me (see the Ngannou vs Gane fight), or it breaks and his biceps will tear (which is more likely).

### Drop and Catch

It consists of releasing the load and catching it again, so it's eccentric training. This can be done with guided loads (bust pulls at 45° on the Smith machine, for example) or with bodyweight. Obviously, this isn't possible with dumbbells, nor does it make sense with elastic bands.

### Fast, Heavy Impulses

This is the ultimate exercise in difficulty and, like the plyometrics, is only for athletes. The aim is to create maximum continuous tension by going back and forth (pulsing) at low amplitude with a heavy load, trying to be as reactive as possible. Jumping off a bench and bouncing as soon as you hit the ground falls into this category, as do pulsed squats on the Smith machine.

## THE MASSAGES

### Gliding Pressure

Sliding pressure massage from distal to proximal (limbs to heart), by rhythmically contracting and releasing the muscle (flexing/extending the joint) is an excellent technique for increasing muscle length, decreasing tone, and raising its pain tolerance threshold (L2).

### Transversal Tendon Massage

This involves rubbing the tendon’s tender points transversely (perpendicularly to the fibers). Do not apply too much pressure to avoid triggering inflammation and use your fingers (middle finger reinforcing the index fingers.This should be followed by an application of ice to prevent inflammation the next day. Cross-massage is thought to stimulate collagen regeneration and to break fibrous tissues.

## PREVENTION OF LIGAMENT PATHOLOGIES

Curiously, ligament prehabilitation is an area that has been little explored. My research has led me to discover three methods. The first is to vary the angles of work. In a single plane (e.g., the frontal plane for squats) the ligaments will be less stimulated than if we use a three-dimensional approach. For example, a carpenter will develop thicker ligaments in his wrists than a body-builder (even if the latter generally lifts more weight) because the variety of his movements and the volume of wrist and forearm work are greater in the former. By the same token, a footballer whose sport involves constantly changing the direction of his run and performing zigzags and pivots will have thicker cruciate ligaments than a sprinter who runs straight ahead. In their sports preparation, footballers train to jump on one foot and land on a box after rotating their body 90°, to strengthen their ligaments and stabilize the knee in pivots. This is a 3D movement: a combination of rotation and jumping. A second method is to get the joint used to small misalignments. Caution and moderation are obviously essential in this approach. Finally, the third approach involves working with 'soft' weights (sandbags, elastic bands attached to kettlebells, aqua bags, Bulgarian bags) to stimulate the growth of connective tissue.

### Pandiculations (Rehab : Lig. Caps.)

To strengthen, the ligaments need to be stretched repeatedly in the physiological axis. Extending and bending your legs all the way on a rowing machine gently mobilizes and stretches the knee ligaments. “Stretched" here means "deployed", because the idea is not to increase the length of the ligament, but rather to open and close the joint rhythmically, in other words to perform "pandiculations", as almost all animals (cats, etc.) do when they wake up. The rowing machine is a good exercise for knee ligaments, as it brings the knee into full flexion, without compression.

To take another example, for the shoulder, pandiculations would be the various circles exercise performed with fitness tools called “Indian clubs”, as demonstrated in page 71. An interesting aspect of training with clubbells is that they traction the joint, which promotes a beneficial decoaptation for the ligaments and the cartilage. Clubbells are fitness accessories originating from India and Persia, somewhat unjustly forgotten today.

Pandiculations hydrate the fascia and regulates body tensions. It is a contraction followed by a slow conscious release. Note that it's not a muscle stretch per se, but rather a way to delay the onset of the stretch reflex. For instance bring the shoulders close to the ears by contracting the trapezius muscle, then gently drop the shoulder, feeling the muscle release.

## Joint Centration

Dynamic Neuromuscular Stabilization (DNS) is a Czech physiotherapy method based on developmental kinesiology (the motor development of newborn babies). In particular, it uses 360° abdominal breathing (abdominal expansion in cylinders, forwards, backwards and to the sides), co-activation (co-contraction) of the body's stabilizers (abs, etc.) and joint re-centering to realign the joints and increase their contact surface. This makes movements more efficient and protects the joints. One way of achieving this centering is to strengthen the phasic muscles (postural muscles) and relax the tonic muscles. That's a short summary; to explain it in detail would be beyond the scope of this booklet.

A basic DNS posture: that of the newborn at six months old. The sacrum is against the floor, hands grip the insides of the feet, and the legs are slightly bent

## Decompress the Joint (Rehab : Cart. Tend. et Caps.)

Just as the spine can be decompressed (e.g., inversion table), each joint can also be distracted (pulled), using elastic bands in particular. For the hip, simply bend and extend the leg with a rubber band attached to the ankle, lying on your back. This type of exercise brings immediate relief. Kelly Starrett's 'mobility W.O.D. stretches, inspired by the 'Mulligan concept', which consist of 'distracting' the joint with elastic bands to overcome restrictions or bone conflicts, also fall into this category.

## Voodoo Bands (Rehab. Tend, Lig. Caps.)

These elastic compression bands sometimes provide instant relief from stubborn joint pain by increasing local blood flow, thus draining the joint of its toxins. Their analgesic action is real, and having tested them, I recommend their use, particularly for certain types of elbows, ankle, wrist, and knee pain, that are complicated to treat because they are deep-rooted. At the moment, they have not been scientifically validated, but, as they say, "the proof is in the pudding", so if it gives you relief, do it! The rule is 50% tension in the elastic and 50% overflow on the band underneath, in order to make 20 movements in the movement that is causing the problem, i.e. around 60 seconds.

### Release the Joint Capsule

While stretching ligaments is disastrous, it is often useful to try to increase the capsular space in the event of a conflict (tendon/bone or bone/bone clash). The knee capsule, for example, is a restricted space shared by tendons, cruciate ligaments, menisci, synovial fringes, and bursae. All these elements can sometimes feel cramped, particularly when inflammation causes swelling of the tendons, especially as the menisci can become twisted and the bursae swollen. So, it's a good idea to stretch the capsule (The ligamentous sheath of the joint) when you feel pain. For the shoulder, it's quite simple: simply hang from a pull-up bar (feet can rest on the floor, hips at a 90° angles) and for the knee, sit with the leg bent in front of you at 90° and press the heel into the floor, pulling the shin towards you with an elastic band. Another technique is to place a stick in the crease of the knee and squat down on your toes (these exercises are described in detail in the practical section). For the elbow, you can place a ball in the hollow of the elbow and pull a rubber band attached behind you, with the elbow above your head. These exercises should last at least 2 min and ideally 10 min (with breaks if necessary), as the fascia needs this time to stretch properly. Take a look at page 56 for a capsular knee stretch exemple.

### Learning to Tolerate Misalignments (Prehab : Lig.)

Anyone who has competed in contact or team sports knows that it's impossible to have total control over your posture in the heat of the action. So why not prepare for those 'bad positions' (e.g., knees over the ball of the foot, rounded back, adducted ankles) to inoculate yourself against injury? This approach is controversial, as there is no guarantee that the body will adapt, and the technique is difficult to calibrate. However, when properly measured, it has been used successfully by Ben Patrick "TheKneesOverToesGuy", Ido Portal and top sportsmen and women, particularly MMA practitioners (Tony Ferguson, for example). The important thing is to progress very gradually and without causing pain.

For example, squat on the floor with your knees on the outside or inside of your feet, then with your toes turned in different directions. The idea is to use your creativity to break out of your usual patterns and learn to tolerate the discomfort associated with slight misalignments. In this way, your tendons and ligaments will become more resilient during accidental joint decentrations.

You can also walk for about thirty meters on the inside or outside edges of your feet, perform an exercise of controlled loaded spine flexion called the Jefferson Curl, practice push ups variations by changing the position of your hands

The "Sisyphus Squat", or "Sissy quat", is an exercise that use to be demonized by physiotherapists (the knee cap extends beyond the ball of the foot), but if done correctly and progressing gradually, it will strengthen them. It is essential in this exercise to raise the height of the heels by one or two inches.

In some sports, maintaining perfect alignment is not a realistic goal. That's why the versatile training of strongmen prepares them to perform even in 'toxic' postures, to make them more resilient, which translates into thicker ligaments and tendons. The high rate of injury in this sport is due less to the type of exercise practiced (for which they are well prepared) than to the frequency of competitions, which leaves them too little time to recover fully.

### The Chaos Training: a little-known type of training

Chaos training is an alternative, fun way of training. The emphasis is less on technical perfection than on a variety of work angles and types of loads. This type of functional training is similar to farm work, as it is carried out on ground that is sometimes uneven, with loads that are asymmetrical, of different densities, difficult to grip (pieces of wood, large stones, tires) or downright unstable or soft (tubes filled with liquid, sandbags). Training in this way stimulates the growth of connective tissue and strengthens areas left out of traditional strength training, such as the fingers, wrists, obliques, neck, and forearms.

Sledgehammer strikes are a clever way of strengthening the ligaments in the wrists, elbows, and shoulders. It's easy to vary the angle of the strike to stimulate different muscles, and to work on either explosiveness or deceleration.

## FORGING TITANIUM BONES

From the age of 30 onwards, we lose 1 to 2% of our bone density every year. Bones strengthen best with very heavy loads; according to studies, they should ideally be close to four times your body weight. Obviously, as it's impossible to lift such heavy weights concentrically, you have to apply them eccentrically. For the record, quadrupling your body weight represents a two-meter fall for your legs, not really recommended unless you are a Parkour athlete or have a large trampoline in your garden and are a skilled jumper. I guess high diving has the same benefits, but with more risk. This type of training is thought to increase bone density via the production of fibrocartilage, the main type of cartilage that training can produce. But impacts aka plyometrics is just one method, partial reps is another. At the beginning of the twentieth century, a strongman by the name of George Jowett devised a training program based on very heavy loads and an amplitude limited to ten or fifteen centimeters, before joint locking. Strong tendons make strong bones because by "pulling" on the bones, they force them to adapt. The leg press is particularly suited to plyometrics as you can lift your feet off the platform while pushing explosively. For the arms throwing and catching medicine balls after reboud on a trampoline or a wall as well as hitting an heavy bag can promote bone density if done with a proper progression.

Oldtime Strongman George Jovett performing an anvil shoulder clean and jerk, weighing 180 lb., with one arm!

In the U.S., the Osteostrong brand has designed special machines to stimulate the formation of fibrocartilage and strengthen bones by applying enormous loads, in ramps (of increasing intensity) and in the axial direction (length of the bone). Bones are four times stronger than concrete: one in³ (a cube measuring 1" on each side) can withstand 20.000 lb.!

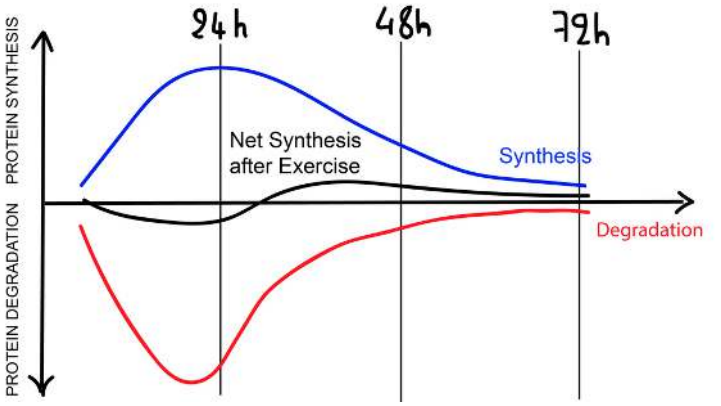
A study carried out by the inventor of this method shows that after six months of training, at a rate of 10 minutes per week, the participants recorded a 14.9% gain in density in the hip bones and a 16.6% gain in the spinal column. These figures are open to question, however, as they appear to be very (maybe a little too) high. Further studies are needed to confirm the effectiveness of these machines.

## CARTILAGE ALSO RENEWS ITSELF

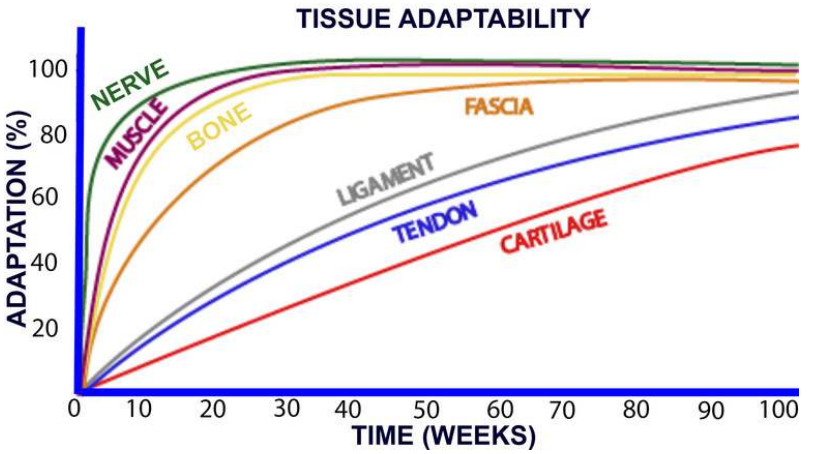
Recent studies show that the body can rebuild real cartilage, not just fibrocartilage, which is an ersatz cartilage, but real, original cartilage. This is particularly true at the extremities (ankles, knees) and to a lesser extent at the proximal level (hips and spine). This property is known as the salamander effect (4), named after the curious animal capable of reconstituting amputated limbs, and is based on an artifact (biological alteration due to external factors) produced by evolution and called MicroRNA. Unfortunately, we haven't yet found a way of stimulating MicroRNA activity to boost this process.

## HOW OFTEN SHOULD YOU TRAIN YOUR TENDONS, LIGAMENTS AND FASCIAS?

The benefits of exercises that strengthen tendons and ligaments only disappear after 72 hours. In the first 24 hours, collagen destruction predominates, then the opposite occurs (28). See graph below. Training sessions can be spaced at two or even three days apart, since in 48 hours the net synthesis of collagen proteins is at its maximum and therefore does not need to be restarted by a new exercise session. On the other hand, one specialist, Keith Baar, recommends that athletes with a history of injury should exercise daily, up to 3 times a day, no more than 10 minutes, but 6 hours apart.




The graph below (28), representing the speed at which tissues adapt to the stresses of training, shows that after 100 weeks (two years), cartilage, tendons and ligaments have still not reached their maximum level of adaptation, whereas muscles and bones do in 40 weeks and fascias in 50 weeks. Tendons take between 5 and 8 times longer to adapt than muscles, due to their poor vascularization. Cartilage adapts very slowly, and its linear curve suggests that it will be fully adapted in 120 weeks, i.e., two and a half years. The nerves (modulation of nerve impulses) adapt the fastest, reaching their full potential in just five months.



## THE NUTRITIONAL ASPECT

As we have already said, joints are mainly made up of collagen, a substance that the body does not always synthesize in sufficient quantities. After the age of 30, we lose 1% of our capacity to produce this protein every year, and regular consumption of meat, even of good quality, does not necessarily guarantee a sufficient supply. Our ancestors, the hunter-gatherers, ate the whole animal (offal, skin, joints), but today we only eat the noble parts, which contain little gelatine. So, we have to compensate for this deficiency with bone broth in winter and gelatine supplements in summer. If you are a pesco-vegetarian, there is the alternative of shellfish and fish powders, but not eating any animal products is problematic, as collagen is not found in plants. Vitamin C also appears to play a role in the formation of type I collagen (23).

*It is advisable to consume 10 g of gelatine 1 hour before sport with vitamin C.*

To keep your bones in top shape, you'll also need calcium, manganese, magnesium, zinc, vitamin C, K and D (vitamin D increases calcium absorption) and a sufficient quantity of protein and 'blue' fish, which contain more good fats than white fish (not necessarily blue, but with an arrow-shaped tail: sardines, tuna, etc.).

You also need to pay attention to the acid-base balance, i.e., eat enough vegetables to balance the acidity of meat (and proteins in general). Watch out for coffee too, because if you drink more than two cups a day, it reduces calcium absorption.

Other collagen supplements include gelatin-based desserts (Jello), chicken feet (a Chinese favorite) and dimethylsulphoxide (DMSO). Matcha green tea boosts natural collagen production.

For remineralization, think of alfalfa and nettle, an anti-rheumatic plant rich in Si, Ca, Fe and Pe. Oats contain silica, Fe, Mn and Zn, bamboo (Si) and horsetail (Ca and K).

Omega 3 is arguably the best supplement for joint pain with quick and noticable effect. I recommend buying high-quality ones because I personally had very different results depending on the brand.

# PART THREE: THE EXERCISES

*Ideally, joint strengthening exercises should be separated from the training session by around 6 hours. They should take no more than 10 minutes and should stimulate the tendons and ligaments without being exhausting or self-defeating. If you notice that your tendons are more supple, that's a good sign. You can just do the exercises in your weak areas or incorporate them all in a rotation to strengthen your body overall.*

## THE WRIST

For many of us, especially women, the wrist is a 'fragile' joint with limited mobility (very few of us have 90° of active flexion at the wrist), which poses problems not only for simple palm supports (push-ups, for example), but even more so for handstands and bridges in gymnastics. Few athletes take the time to strengthen their wrists. Yet strong wrists transfer their strength to all upper-body movements. The few athletes who train their wrists seriously are gymnasts, baseball players, rock climbers and martial artists.

*Recommended accessories: hammer, tray filled with rice, Therastick, Powerball, tennis ball, thick office-type rubber band.*

### Strengthening Wrist Cartilage

1) Quadruped walking
It's a primal movement that gently strengthens the upper limbs and gives your abs and shoulders a thorough workout. To practice it over long distances, your shoulders, elbows, and wrists need to be relaxed. Move forward on all fours, relaxing your shoulders, elbows, and wrists as you pass each arm, keeping your shoulders and pelvis at the same level and parallel to the ground (no twisting). To increase the difficulty, practice on sloping or uneven ground (e.g., a tree trunk on the ground) or try to place your hands and feet on the same line as a cat. Indoors, you can lift the opposite arm and leg while staying in place. 3 minutes or about 300 feet.
*3 minutes or about 300 feet.*

2) Fist pumps for wrist stability
It's an exercise I've practiced hundreds of times in the martial arts.
Do push-ups on your fists (start on your knees if it's difficult and then switch to a plank). The important thing is to keep body tension to a minimum, keep breathing normally and distribute the weight evenly over all the phalanges.
*Duration: until fatigue x 3 sets*

3) Catching a sandbag with your fingers
Throw a sandbag into the air and catch it with your clawed fingers. Sandbells are available from sports shops, or you can make your own using a resealable fabric bag filled with sand.
*Duration: until fatigue x 3 sets*

4) The rice bucket
The rice bucket is a well-known routine used by baseball players, pitchers in particular, and rock climbers to strengthen their wrists, fingers, and hands. The exercise involves plunging your hand as deep as possible into a tray filled with rice and then opening and closing it again quickly, until you're tired. You can also do flexion-extension, wrist flexion, radial and ulnar tilts, "8" movements with your hand open (in the shape of a spoon) and your fist closed. *Duration; until fatigue x 3 series*

5) Using different Grips for Total Hand Development
In general, I have found much more benefit from doing weightlifting pulls using a thick towel rather than a handle, resulting in better development of the forearms and finger strength transferable to pull-ups. I have also tested different grips like those used by climbers (e.g. a wood sphere) but they tend to slip if not using chalk, so it's not ideal. Climbers' hangboards are fun but too specific. An interesting exercise is to place a thick towel on a table and fold it in half. With the palm of your hand outside the towel, pull the towel towards you with your fingers while pressing the first knuckles firmly against the table. 2 minutes.

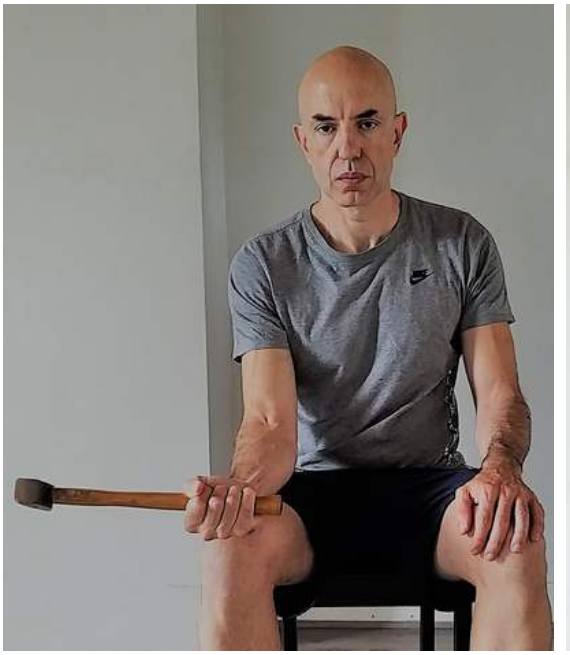
*Practicing pottery and sculpture with clay also helps in promoting a harmonious development of the ligaments in the hand. Cando Theraputty is a silicone putty with varying firmness levels to strengthen hand grip and finger strength through kneading and squeezing.*

## Wrist Tendons

5) Wrist rotations with hammer

Grasp the handle of a hammer and, resting your forearm on your knee, rotate your fist supination and then pronation, keeping it in line with your forearm (without bending). When the exercise becomes too easy, use a wooden handle 40 cm long, to which you attach a 1 kg/1.5 kg disc at the end, with dumbbell clamps. Don't go below horizontal to limit stress on the ligaments.

*12 reps x 3 (each side)*



6) Alternating flexions/extensions with tennis ball and elastic band

Crush a tennis ball in your hand, then open your fingers and pull the elastic band apart. Overall strengthening of the flexors and extensors.

*Until tired x 3 sets*

7) Metacarpal raise (wrist strengthened, palm flat)
Kneeling with your arms outstretched, lift your palms off the ground and rest them, maintaining constant pressure on the heads of the metacarpals (the bony bumps where the fingers meet the hands). Change the position of the hands so that the fingers point successively forwards, backwards, inwards, and outwards, then do the same with the back of the hand on the floor, also in the four directions and with the arms extended as far as possible. The more weight you transfer to your hands, the more difficult the exercise will be. *10 reps in each position for a total of 80 reps*


8) Spin with Therastick
Twist a Therastick (or a large rolled-up towel soaked in water) in one hand, keeping the other hand steady. *10 reps in each position: supination, pronation, right hand, and left hand fixed, alternately.*


9) Torsion with Therastick
Bend the Therastick, downwards, then forwards, backwards and upwards, pronating and supinating. *15 reps x 2 for each variation*


10) Whisk with Therastick
Holding a Therastick firmly by the end with your arm outstretched, swing it back and forth, gradually increasing the amplitude and speed.
*One minute per side*

## Wrist Stability

11) Bottom up kettlebell walk
Walk holding a kettlebell upside down. If your shoulder is cramping bring your arm in a rack position, elbow touching your body.
*2 times on each side until you feel tired*

## Neuromotor Control of the Wrist

12) Power ball
This exercise, which involves rotating a gyroscope as fast as possible, needs no explanation. The key is to maintain a regular rhythm of rotation and avoid tensing up when the speed reaches maximum. The Powerball is frequently used in physiotherapy because it develops the strength and stability of the forearms and offers progressive resistance, which can be gentle for rehabilitation or intense: some models offer over 27 kg of force for strengthening. Exercise until you are tired, i.e. for as long as possible, ideally *3 minutes and 2 sets.*

# THE HIP

The morphology of a knee or shoulder does not differ appreciably from one individual to another, unlike the hips, which vary greatly. You probably know that female hips are wider to allow the newborn baby's head to pass through. Ethnic variations explain why, in some countries, it is normal to squat with the buttocks on the ground, whereas this is not common in Western Europe, for example. The hips of ethnic French (of Celtic origin) have a deep, enveloping acetabulum (the cavity where the head of the femur is inserted), which limits abduction but favors running. Native people of the poles and Asians, on the other hand, have a shallow acetabulum, which results in great mobility in abduction, ideal for the full squat and sports based on lateral movement, but which can lead to instability with age.

*Accessories: mini circular band, power band, kettlebell, slider (or plastic bag).*

Image source: https://paulgrilley.com/ (reproduced with kind permission)

*Two very dissimilar hips: the left hip is clearly better suited to movement in the sagittal plane (front to back) because of the depth and frontal orientation of its acetabulum (the up-like depression in the lower part), whereas the right hip is better suited to abduction of the legs, squatting and lateral movement (skating, basketball), because as can be seen its acetabulum is superficial and turned sideways.*

*A study published in february 2020 in the Osteoarthritis Research Society International Journal compared 456 hips from individuals of different ethnicities: Caucasian Europeans, Caucasian Americans, Africans, and Chinese. Those of the Chinese were the most different from the others, notably with a shallower acetabulum and a more spherical femoral head. Men are more likely than women to suffer from hip arthritis. In Chinese individuals, hip arthritis is reportedly 80 to 90% lower compared to white Americans.*

## Strengthening Hip Cartilage

1) Cycling (normal or "dancer")
Cycling is not only good for the knees but also for the hips

2) trampoline (jumps)
Adjust the magnitude of your jumps to your fitness level and pain level.

3) Aqua Gym: jumping in the pool with water at mid-thigh level
You can also run in the pool (back and forth) and perform side shuffles with water at waist level.

4) The leg press with a light load (30/40kg) in long sets (100 reps or more) or plyometrics (explosive foot push and platform lift). In parenthesis, prefer presses where the body moves relative to the platform rather than the other way round, as they are more functional

5) Bodyweight squats partially unloaded (harness suspended from elastic bands or using your arms with rings or a TRX to pull yourself up) to achieve more repetitions (100 and more).

*Don't be afraid to do hundreds or even thousands of repetitions (extrapolate the number of repetitions from your cadence per minute using a timer).*

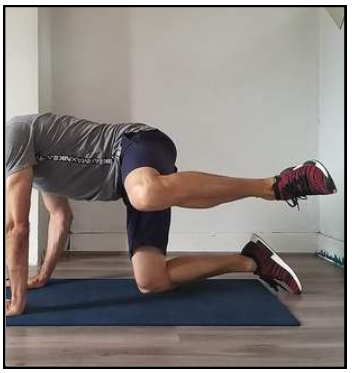
## Hip Ligaments and Capsule

6) Place a strong elastic band around your upper thigh, with the other end secured behind you. Bend your knee and pass your ankle in front of the opposite knee. Move your pelvis slightly backwards, sticking your buttocks until you feel a stretch at the back of the glutes. This is one of the best hips stretches and has the added benefit of re-centering the femoral head.
*2 minutes on each side*

7) On all fours, rotate your body sideways into a "pigeon" position, return to the starting quadruped position and change sides. An excellent exercise for those with stiff hips.
*10 reps x 2 sets*

8) Controlled hip rotations

On all fours, bring one knee to the side and then backwards with an internal rotation of the hip, lifting the foot as high as possible towards the ceiling, without arching the back and keeping the pelvis as still as possible, then bring the knee back to the side, this time with an external rotation of the hip, then to the chest. 5 repetitions on each side, trying to increase the amplitude of the movement each time.


9) Dynamic hip-opening stretching in plank position

With the front leg straight, cross one foot under the opposite shoulder, bending the leg at 90°, lower the pelvis towards the ground (without releasing the abs to protect the back), to stretch the hip, then return to the starting position and change legs.

*10 alternating reps x 3 sets*



## Hip Tendons

10) Hip abduction, side lying
Lie on your side on the floor, hips at 90°. Lift your outstretched leg to the side as high as possible, with your heel higher than your toes, and lower it in a controlled manner. You can do this exercise on a bench to lower the leg and possibly add an ankle weight later.
*15 reps x 3 on each side*

11) Deadlift with one leg straight
Leaning on one leg, slightly bent, tilt your trunk forward to the limit of your flexibility (without bending your back). Return to the starting position, contracting your buttocks strongly. Place the ball of your back foot on the floor if it's too difficult for you to keep your balance. This is a loaded stretching exercise.
*15 reps x 3 on each side*

12) Goblet squat
Holding a kettlebell (or dumbbell) in front of your sternum, squat down with your back straight while pushing your knees out until your elbows touch the inside of your knees. Push explosively with your legs to return to the starting position.
*12 reps x 3*

13) Hip centration

Press your knee against a wall, letting yourself fall forward. This will bring the head of the femur backwards (i.e. to the bottom of the iliac bone cavity), then perform internal and external hip rotations, keeping the pressure against the wall. Super effective exercise, particularly in hip osteoarthritis and capsular injuries.

*20 reps on each side*

14 a) Strengthening the internal hip rotators

No functional hips without strong rotators! Lie on your side with your hips bent at 45°, place a yoga brick widthways between your knees, a rubber band around your ankles and perform internal hip rotations with your feet apart. *10 reps x 2 series*

14 b) External rotators

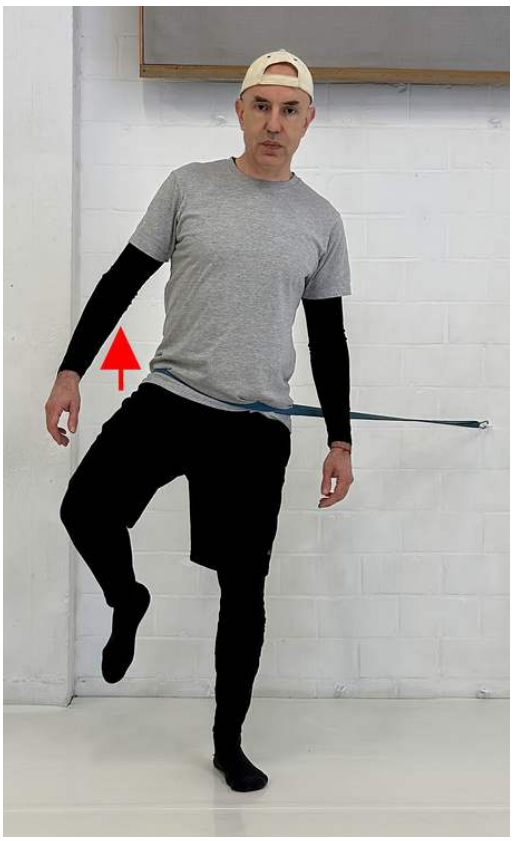
Spread your knees, this time with the elastic around your thighs. 10 reps x 2

*14 a*

*14 b*

15) The one-legged bridge
Lying down, raise your pelvis towards the ceiling by pushing on the heel of the foot on the ground (the other leg stretched out in front). Rest the buttocks and alternate with the other leg. Keep your pelvis in retroversion throughout the exercise. (If it's too difficult, start with the double leg version). *15 reps x 2*

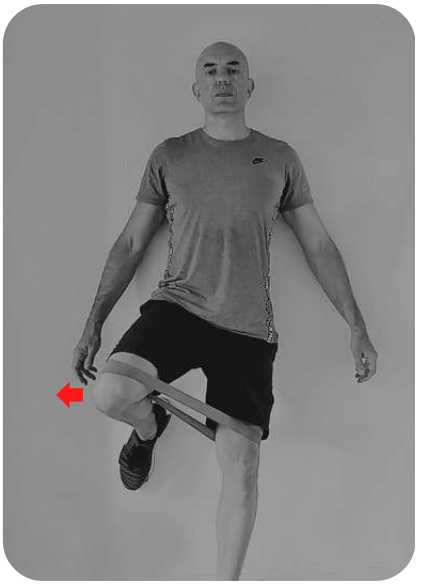
16) Hip drop
Fantastic activation exercise for the gluteus medius! Working under load is always more intense because the glutes have to work harder to stabilize the body weight. Attach a rubber band to a sturdy anchor point and then pass it around your hips. Balancing on the leg on the side of the attachment, drop the hip, then raise it against the resistance of the elastic. *15 reps x 2 on each side*



## Hip Stability

17) Oblic seat

The oblique sit-up is a fundamental exercise in DNS (Dynamic Neuromuscular Stabilization). Sitting sideways with one leg bent at 90° to the floor and the hips flexed at 45°, press the outside of the knee into the floor to lift the pelvis (the hip above rolls over the other to align the pelvis vertically). Return to the starting position and repeat the movement. *15 reps x 2 on each side*



18) Mini band on the wall

With your back against a wall, leaning on a bent leg with a mini band around your thighs, spread your knee and pivot the ball of your foot against the wall. This exercise, which is more intense than it looks, isolates the hip rotators.

*15 reps x 3 on each side*

19) Seated Clam shell

Sitting on a chair, spread your knees as wide as you can, keeping the soles of your feet flat on the floor. *15 reps x 3 on each side*

20) Side squat with slider

Place one leg bent against a wall with a slider (or towel) between the two. Lower your other leg as far as you can, keeping your pelvis stable. Let yourself fall against the wall to force the hip to resist abduction. *12 reps x 2 each side*

21) The helicopter

Balancing on one almost straight leg, pivot from the hips, slowly turning your torso inwards and then outwards, with your arms crossed. *15 reps x 2 on each side*

Start with the supporting leg almost straight, back straight, and the line of the shoulders and hips parallel to the ground.

Pivot to the right side in a controlled manner, closing the angle between the pelvis and the right hip while contracting the adductors on the right side.

Pivot to the left while engaging the right glute. Keep the lines of the shoulders and pelvis parallel.

# THE KNEE

The knee is the largest joint in the body. It stands out from others by the presence of cartilaginous pads called menisci (from the Greek word for "crescent"). No one has the same shape of patella; it is an anthropometric signature and is not essential for walking. Newborns, in fact, do not have them. In addition to the menisci, which prevent bone friction, there are 14 small fluid-filled sacs called bursae (from the Latin word for "bag") filled with synovial fluid (resembling egg white, hence its name derived from "ovum," egg). Knees endure a lot of pressure: for example, if you weigh 80 kg, your knees receive 320 kilograms of pressure, four times more when you squat, and 1.5 times your weight (120 kg) when you walk.

*It is not uncommon for knee cartilage to 'wear out' prematurely without trauma or intense activity being to blame. Certain degrees of flexion then become painful, causing apprehension when running, jumping, or simply climbing a flight of stairs. Other times, it's a bent meniscus or a partially torn ligament. I've often noticed that those prone to knee pain tend to load it via rotation. Even though the knee often suffers, as it is affected by hip and foot dysfunctions, it is nevertheless a robust joint that will surprise you with its resilience if you strengthen it methodically.*

*Accessories: step, "tirante musculador" / ab straps or fabric buckles, dumbbell weighing approx. 13 lbs.*

## Knee Cartilage

1) Cycling for 20 minutes (10 minutes before your workout and 10 minutes afterwards) is the basic exercise for keeping your knees healthy, particularly if you have cartilage or meniscus damage.

You can also practice as an alternative:

*2) Elliptical trainer (15 min)*

*3) Jumping on a trampoline (6 min)*

*4) Rope skipping (6 min) or simple hopping on the spot, using Nordic walking poles if necessary to take the weight off your body.*

*5) Rowing with knees fully bent (10-15 min)*

6) Stretch capsule with elastic band
Sitting on the floor with one leg bent 90° in front of you, press your heel into the floor as if doing a leg curl, while pulling the upper end of the tibia towards you with a thick elastic band (or, failing that, a strap). Repeat this maneuver about ten times for four sets, to stretch the capsule.

7) Assisted tibial rotation
Bring the forefoot into abduction by pulling the knee towards you with your hand, then into adduction by pushing the knee outwards. Repeat about twenty times on each side. If the tibial rotation is incorrect, the ligaments and menisci will suffer, hence this exercise.
Make sure you rotate the tibia and not the ankle. In the photo, I've got my hand on the tibia to check that it's really moving.

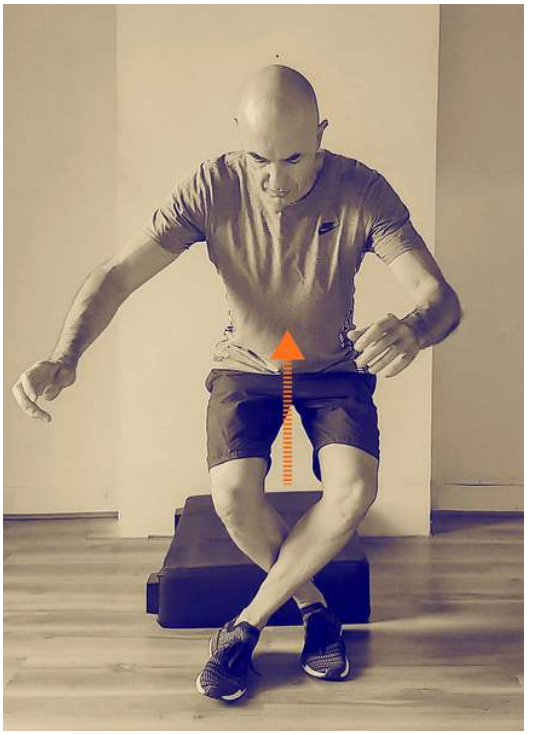

8) Capsular stretch with stick
Here's the aspirin for a sore knee. Place a stick (not too thick) in the crease of your knee and squat down, balancing on the balls of your feet and leaning either on the floor or on a piece of furniture in front of you. Stay in this position for one minute, increasing every two days by 30 seconds, to eventually reach 10 minutes. Remain stoic and take breaks at the beginning, as this exercise 'stings' a little. For a softer variation, use a rolled towel.

## Knee Ligaments

9) Barefoot run
Running barefoot, preferably changing direction (zigzags)on grass (or even better sand) is excellent for strengthening knee ligaments.

9) Cross and uncross the shins
Lying on your stomach, loosely cross and uncross your legs, swapping the leg above you each time. This "Chinese" exercise, revealed by American wrestler Matt Furey, is excellent for both knee and hip health!
*40 times*

10) Strengthening cruciate ligaments
Sit cross-legged on a step about thirty centimeters high (as you progress, you will reduce its height until you finally do the floor exercise). Stand up by pushing on the outside of your feet, then slowly and carefully lower yourself back down to a cross-legged position.
Warning: this exercise strengthens the cruciate ligaments as a preventive measure but is not indicated in cases of osteoarthritis.
*6 Reps x 3 sets*



11) Closed chain extension with band
In the front lunge, place a rubber band (35kg of resistance) behind the knee of the supporting leg, with the back leg resting on the balls of your feet (weight distribution 90%-10%).

While resisting the elastic, straighten your leg all the way, contracting your quadriceps (not your hamstrings, this is important). Make sure you push down on the front of the foot, rather than pulling the knee back. This will help you target the quadriceps and in particular the lower, medial portion, which is so important for knee health. 10 reps x 4 sets

12) Barça squats
This squat, popular with Spanish footballers, prevents and cures patellar tendonitis. Connect two wide loops of fabric to a strap secured to a sturdy attachment point (here, I'm using two ab straps and a yoga strap, but you can also use fabric).

Pass the buckles up your calves. Slowly lower yourself down until your thighs are parallel to the ground, then explosively raise yourself back up. If you're afraid of falling backwards, hold a rope between your hands. *10 reps x 5 sets*

13) Running backwards on a treadmill
Tilt a treadmill at maximum incline (15°) and set your speed at between 3.7 and 5 mph. Trot as if you were running backwards up an incline. The eccentric component of this exercise strengthens the quadriceps tendon and relieves knee pain. Alternatively, while walking backwards, you can use your legs to move the treadmill (which is then stationary). You can also run or walk backwards up a real hill, or simply run backwards on a flat surface. *15-20 minutes*

14) "Sissy" squat.
Standing with your feet hip-width apart and your heels resting on two 44 lb. Olympic discs (or a 4" thick piece of wood, or two large books), bend your legs by bringing your knees forward and leaning your trunk back. Contract the glutes and keep the pelvis in retroversion to avoid arching the back. Pull yourself up by contracting the quadriceps. Advanced pre-rehabilitation (strengthening) exercise to be performed very gradually (not indicated if it still reproduces your symptoms after 3 weeks). *12 reps x 3 series*

15) Sled drag
If you have stubborn knee pain, it might be worth investing in a sledge. The cheapest is a used tire cut in half with a wooden board cut into a circle in the middle, or a sturdy sack connected to a rope and two handles, or a plastic winter sports sledge. Load it with 44 to 80 lbs. and

walk backwards in a low position as if you were sitting in a chair, letting your knees pass over the ball of your foot. Guaranteed to improve the health of the quadriceps tendon. *Perform a set of 15 minutes*

## Knee Stability

16) Multiplanar pistol squat

Balancing on a step or bench, slowly bend your supporting leg (as low as possible) while spreading your other leg (stretched out to the side). Return to the starting position and repeat the movement, this time crossing the leg behind you and a third time extending it forwards. Come back up by pushing with the ball of the foot, the knee of the supporting leg should remain in line with the second toe and the pelvis should not tilt sideways during the exercise. *12 reps x 3 sets*



17) Knee stability in rotation

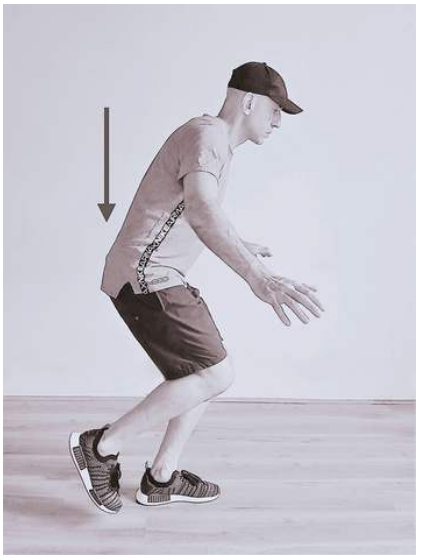
Balancing on a bent leg, with a light dumbbell in your hands, suddenly turn your torso sideways and immediately return to the starting position without moving the knee of the supporting leg a millimeter. This exercise is more difficult than it first appears and teaches you to separate the hip from the knee. *12 reps x 3 sets*


18) Pivot jump

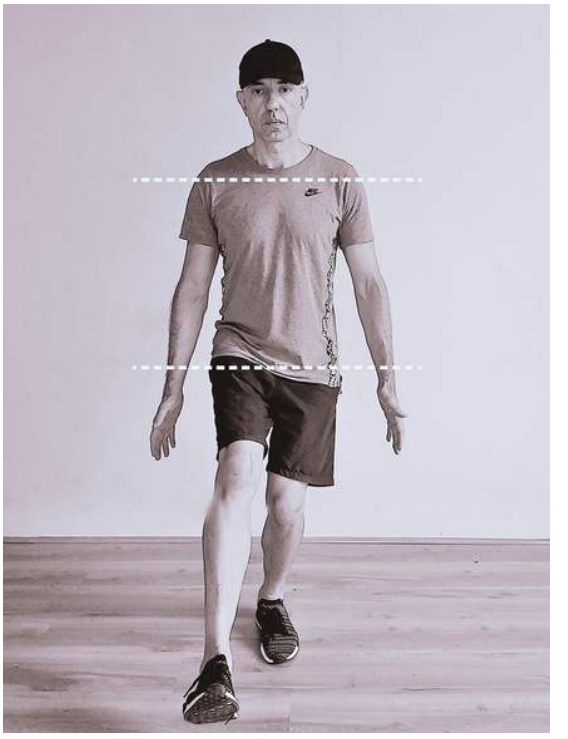
Jump with one leg onto a step (8 to 12" high) and turn 90°. Take particular care to keep the knee aligned, as it should not extend beyond the ball of the foot and should remain in line with the third toe. Try not to crush the arch of the foot on landing and to keep the pelvis parallel to the ground (the hip in the air must not fall). Walk back down the step and repeat the exercise. This strengthens the ligaments of the knee and its dynamic stability. *10 reps x 3 sets*

Bent leg and body profile to landing point

Jump and pivot, landing with the knee above the second toe. Increase jump height with training



19) Fall recovery
Standing and balancing on one foot, simulate a fall by suddenly releasing the supporting leg. In the middle of the descent, stop the movement by suddenly contracting the quadriceps. You can start the exercise on both feet if it's too difficult on one foot. This exercise allows you to work on deceleration. *8 reps x 3 sets*

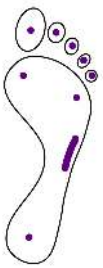


20) Half 'Pistol squat' for postural control
Balancing on one leg, slowly lower yourself down, keeping your knee in line with your second toe and your hips horizontal. Repeat the exercise with your eyes closed, filming yourself to check for any imbalances. *3 times on each side*

21) Balancing with eyes closed
Balance on one leg, eyes closed, with your pelvis perfectly horizontal. Increase the duration to one minute, starting with twenty seconds.

# ANKLE AND FOOT

*Nature is well done, because ankles are not very prone to osteoarthritis, which would make walking, the quintessential human activity, painful or even impossible with age. However, it would be a mistake to think that strengthening the foot or ankle is pointless, because the arch of the foot and the stability of the ankle have a considerable impact on the health of the knees and hips. Ruptured Achilles tendons are a sportsman's nightmare because they are so hard to heal. Kobe Briant said that of all the injuries he suffered in his career, the Achilles heel was the worst to treat. The foot has a complex structure designed with 26 bones and 33 joints that function in harmony with 19 muscles and not less than 107 ligaments. For the record, if you know the lenght of the foot, you can deduce roughly the height of the person multyplying by 100 and dividing by 15. This ratio is used by forencics for profiling unsubs.*



*A foot that collapses due to lack of tone disrupts the functioning of all the joints. There are 9 points of contact between the foot and the ground, which should be felt when barefoot. Babies are born with flat feet. In the early years of childhood, the arch of the foot begins to take shape. Indeed, in most children, this arch gradually develops as they grow. This process typically occurs before the age of 3.*

Many athletes (jumpers, sprinters, dancers) have developed a high arch due to their training, which has promoted the development of fascia and intrinsic foot muscles. However, those who are born with an excessive arch without the accompanying muscular and fascial development (high-arched or "cavus" feet) may suffer from metatarsalgia (inflammation of the metatarsal heads), toe deformities, fasciitis, or instability.

## Cartilage Strengthening

1) Walking or running, ideally barefoot or in minimalist shoes with a low heel, on soft ground (sand or grass). Gradually (over several months).
From *5 to 20 minutes*
2) Cycling is an excellent exercise for mobilizing the ankles, but the saddle must be adjusted so that the ankles are not flexed too much, which would irritate the Achilles tendon.
3) Jumping on a trampoline or jumping/stomping on an Airex mat.
*6 minutes*
4) Skipping - *3 minutes x 2 sets*

5) Tensioning of ligaments by joint decentrating
Walk 300 ft on the balls of your feet, then the heels and finally the edges of your feet (inside and outside).

6) Roll to squat
Switch from the full squat position to kneeling on the floor and back again. This exercise is an example of dynamic stretching of the toes and plantar fascia.
*Repeat 15 times*

7) Weighted ankle stretch
In a semi-squat "puller" position, with an 18-26 lb. kettelbell on your knee, move your knee forward to stretch your ankle. An excellent exercise to prepare for the full squat.
*2 min on each side*

8) Place a rubber band between your foot and your heterolateral shoulder (diagonally) and step onto a step. Perform ankle flexion-extensions as you go all the way down, to stretch the calf. The elastic increases the difficulty of the exercise and activates the crossed activation patterns. *20 reps x 3 sets*

9) Dissociation of the toes

Standing, lift the big toe while keeping the others on the ground, then do the opposite (big toe on the ground, others off). This is a good exercise for avoiding "bunions" and strengthening the small muscles of the foot. Resist the tendency to put your body weight on the outside of the foot to lift the big toe more easily and on the inside of the foot for the other toes. To do this, simply do the opposite (weight on the inside of the foot when you lift the big toe and on the outside of the foot for the other toes). 20 reps x 2 sets.

10) Towel pulls with toes

Place a few pounds of weight on a towel on the floor, put your foot on it and gradually pull it towards you, bending your toes and digging your foot in. Start doing the exercise without weights to get used to the movement.

*10 reps for each foot*

11) Side hopping
Do small lateral jumps, landing on the forefoot. Make sure you do the exercise at home in front of a mirror to check that the inner arch of the foot is not crushed on landing.
20 reps x 2 sets foot

12) Tibialis anterior activation
The tibialis anterior is particularly important for running deceleration and ankle stability. With your back to a wall, move your feet forward about 15 inches, and pull the tips of your toes towards you. The further you move your heels away from the wall, the more difficult the exercise will become. *40 Reps x 2*

## Ankle Stability

13) Arch of the foot work with stick
Without a toned plantar arch, pronation is not possible, and the knee cannot be correctly aligned. Like a "knight in shining armor", slide the stick along the outside of the foot and inside the knee. Push the knee outwards with the stick while moving the pelvis forward. This will transfer pressure to the outside of the foot and increase the arch of the foot.
*2 minutes on each side*

14) Catch marbles with your foot
To develop the arch of the foot and strengthen the tibialis anterior tendon (which is especially important for knee health), I advise you to pick up marbles with your toes, tucking them under the second toe and placing them in a cup. To pick them up, don't dig your feet in but rather retract your toes as shown in the photo. All the tendons of the toe flexors should be visible.
*20 reps and one serie*

15) Formation of the arch of the foot by increasing metatarsal support.
Balancing on one leg, grasp a rubber band attached to the outside of the supporting leg with both hands and bend forward from the hips, then straighten up, making sure to keep the handle of the rubber band in line with the supporting leg. It's a great exercise that's guaranteed to cause cramps in the buttocks if you do it correctly. Keep your forefoot firmly planted on the ground throughout the movement, especially around the heads of the metatarsals - the bony bumps on the forefoot just before the toes.
*10 reps x 3*

## Neuromotor Control of the Ankle

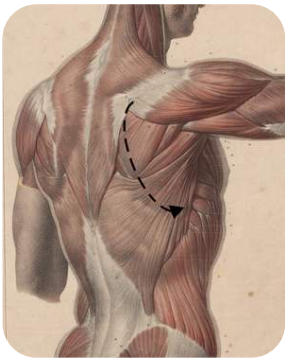
16) Proprioception work on the rice bucket
Fill a tray with rice, dip your feet in up to the ankles and wiggle them in all directions. This will awaken muscles you didn't even know you had and will help to release the negative energy of a hard day's work. Preferably do this in a deep bucket to avoid having to vacuum right afterwards.

17) Lacrosse ball massage
Vigorously roll a Lacrosse ball under the sole of your foot, paying particular attention to areas of tension. This is the best way to mobilize the bones in your feet.
*3 min*

# THE SHOULDER

*The human shoulder is an extraordinarily versatile instrument. It is both strong mobile and precise, enabling us to hang from one arm, to throw a ball at 100 mph, as in baseball, or to support the full weight of the body in an upright, inverted stance. It is also extraordinarily precise when it comes to sending a dart into the bull's-eye. Unfortunately, this joint pays for its versatility with fragility, as shoulder injuries are quite common in all sports. The shoulder is the joint the more prone to dislocation and it relies heavily on muscular support compared to other joints in the body. Because the shoulder lacks a bony socket and requires extensive movement, its stability and control are primarily maintained by muscles that attach to it, securing its position. That is why developping shoulder stability is essential. The shoulder shape of modern humans is distinctive, as it combines the lateral orientation observed in orangutans with the scapular blade shape found in African apes, placing humans somewhere in between these two primates. In the event of shoulder conflict or rotator cuff tendonitis, we advise you to exercise with the elbow at 90° and perform uppercut-type movements with the palm of the hand turned towards you, initially working with elastic bands, then progressing with dumbells. For the record, in women, frozen shoulder iis sometimes associated with perimenopause.*

*To protect the shoulder during push and pull exercises think of scooping the shoulder blade as if you would like that its inner part face the sky (It's not just a downward movement, but a sort of scooping motion). Think also to suck the humeral head inside the glenoid cavity using your rotator cuff muscles.*



*Accessories: elastic bands (one very thin, the other thicker), tennis balls, 2.5kg/3kg weights, club (or hammer).*

According to surgeon John M Kirsch, hanging passively from a bar for 30 seconds three times a day would eliminate 99% of shoulder pathologies. This is certainly an exaggeration, but it is true that regular suspension for a few minutes a day is very beneficial both for health and for shoulder mobility by stretching the joint capsule. For suspensions to be beneficial for the shoulder, you need to have good flexion: to be able, when lying on your back with your arms back, to have your wrists touching the ground. If not, long suspensions risk stressing the shoulder ligaments.

## Shoulder Cartilage

1) External shoulder rotations with Indian clubs weighing
With the club of 1 to 2 lb. (or a hammer) in one hand, raise the elbow palm inwards, crossing the midline of the trunk. Once the club is parallel to the ground, externally rotate the shoulder and spread the elbow, passing the club behind the head. Throw the club diagonally towards the ceiling and let your arm fall back in a semi-circle to the side. Follow through smoothly. *4 minutes per side*



2) Quadruped walk
Walk on all fours, alternately lifting your arm and your opposite leg. Keep your shoulders and pelvis parallel to the ground (see the "wrist" section for a description of the movement). *3 minutes or 300 ft..*

3) Shoulder pulses
Stand up, grasp an elastic band attached to a 2 to 3 kg weight hanging in the air and push your arm upwards (shoulder flexions of a few centimeters amplitude).
*100 repetitions on each side.*

## Shoulder Capsule and Ligaments

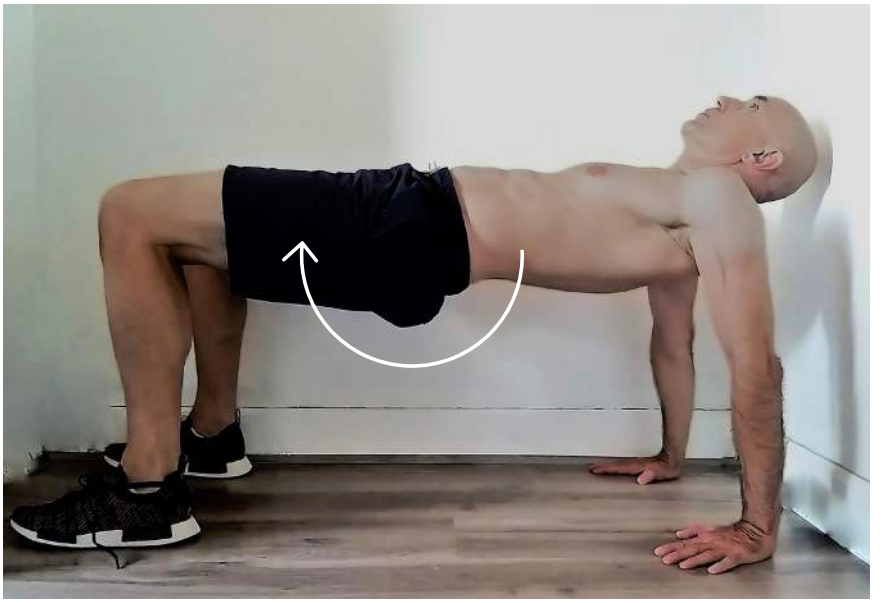
4) Chest opening in the corner of a wall

Place your forearm bent at 90° against a doorframe or flat against the corner of a wall (see photo) and do a forward lunge (leg forward on the same side as the bent arm). Push your elbow against the wall [6 secs], then try to lift it off the wall by pinching your shoulder blades without moving your torso [6 secs] and finally stay in a passive stretch [6 secs].

*Repeat this cycle for 1 minute.*

5) The table

Sitting on the floor, straighten your arms and raise your pelvis to shoulder level, contracting your buttocks (keep a posterior pelvic tilt). Lift your ribcage well to stretch your upper back. Lower the pelvis and repeat this movement for 2 minutes.



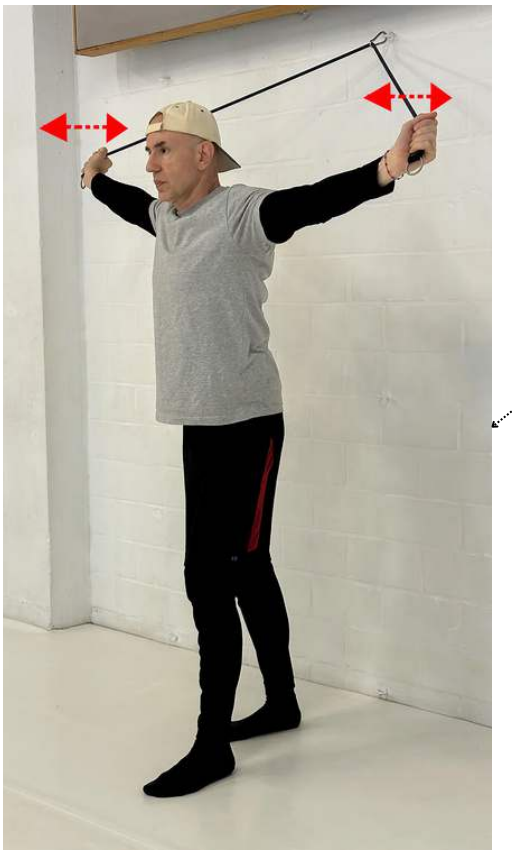
## Tendons of the Shoulder

6) Mobilizing the shoulder with band circles

Grab a light elastic band hanging high behind you and make small circles with your arms outstretched, bringing your arms down and then back up (change the direction of the circles). Then do back-and-forth beats, with your arm stretched above your head, your arms in a cross and finally your arms pulled back. This simple exercise helped me heal a tendonitis of the supraspinatus that had been bothering me for over 3 years and against which all other methods had failed! *Do it for 3 minutes.*

Back-and-forth beats with your arms above your head

*Small circles with your arms outstretched, bringing your arms down and then back up (change the direction of the circles)*



Back-and-forth beats with your arms in a cross

Back-and-forth beats with your arms pulled back.

7) Cuban" 90°/90° rotations

With your back to a wall and your arms bent at 90°, rotate one arm upwards while trying to pin your wrist to the wall and simultaneously rotate the other in the opposite direction. Keep your shoulder blades low and close together throughout the movement.

*6 times on each side*

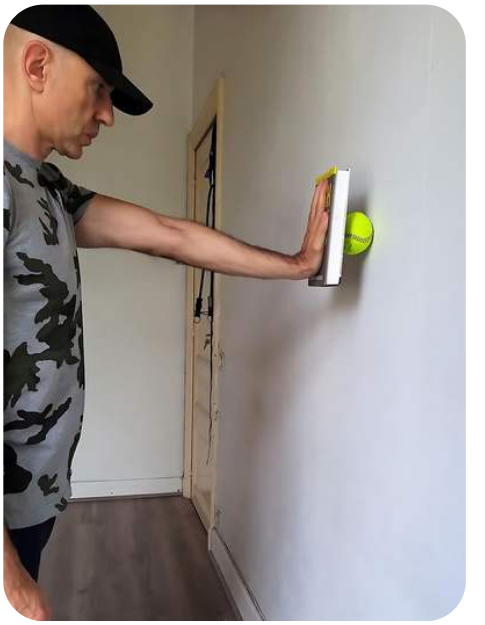
8) Explosive Bench Press

Drop against the back of a park bench, cushioning the fall with your arms, then push yourself back explosively by clapping your hands.

*50 repetitions*

## Shoulder Stability

1) Shoulder to wall stability
Perform small shoulder circles by rolling a tennis ball between a book and the wall. Let your body fall slightly forward to center the humeral head.
*20 times clockwise and counter- clockwise on each side*



10) Crab/table transition

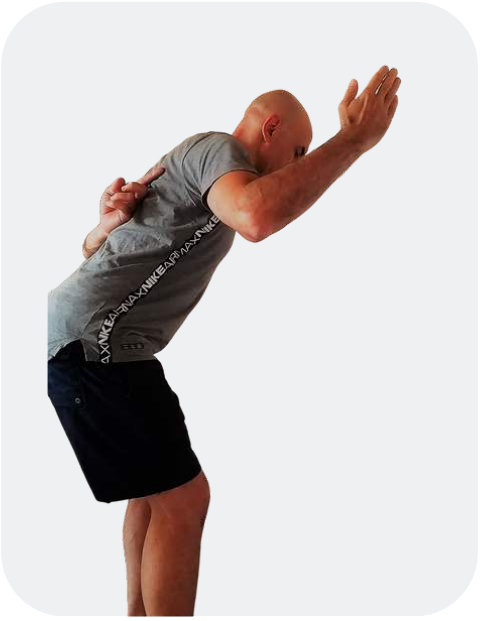
Move in a controlled manner from the "crab" position to the "table" position by an internal shoulder rotation, raising one leg and using the other as a pivot. Return to the table position and repeat six times. Superb exercise for shoulder health.
2 sets

## Neuromotor Control Of The Shoulder

11) Scapula control when raising the arm

With your arm bent at right angles and your body bent forward at 45°, bring your other arm behind your back, index finger in contact with the lower edge of the heterolateral scapula. Slowly raise your arm keeping the scapula low without the inside edge lifting off. Stop as soon as you feel the shoulder blade move or the upper trapezius (the area between the neck and the shoulder) contract.

*10 repetitions on each side, two sets*



12) "Walk" of the shoulder blades against a wall.

With your upper back resting against a wall, lower yourself into a squat and then raise yourself up by "walking" with your shoulder blades, i.e., moving one shoulder blade after the other. Deliberately accentuate the movement. *10 times*

13) Inhibition of the upper trapezius
Raise your arm, relaxed, without using the strength of the trapezius. Learn to use the area under the shoulders, i.e., the armpits, instead. To do this, tap the trapezius throughout the movement to make sure it remains soft and relaxed.
*20 times on each side.*

# THE BACK

80% of us will suffer from back pain at some point in our lives. I like to compare a dysfunctional spine to a bicycle chain where a few links have seized up. When this happens, the mechanical stress is transferred to the other vertebrae, which wear out more quickly. Since the back is a stack of 24 vertebrae, good motor patterns are essential to prevent them from 'derailing', i.e. lumbago, which is nothing more than a 'misdirection'.

*Accessories: kettlebell or 13 lb. dumbbell.*

## Cartilage

1) Jumping on a trampoline
*10 minutes*

2) Walk with weighted rucksack
Walking a few miles with a 20 lb. weighted rucksack (rice or sand) straightens and strengthens the back. This exercise, which promotes lumbar lordosis (the bag pulls the shoulders back), helps to reduce herniated discs. If, on the other hand, your symptoms worsen with extension, this exercise is not recommended.
*Length: one mile*

## Capsule and Ligaments Of The Back

3) The cat/camel

On all fours, do the back of a cat by pushing the middle of your back towards the ceiling, then dig into your back like a cat stretching. This exercise "lubricates" the vertebrae and increases the segmental mobility of the spine. 10 times x 2 series, making sure to move each vertebra.

4) Sidewaves

Standing with your legs shoulder-width apart, place the fingers of your left hand on your breastbone and those of your right on your navel. Bring the fingers together as you round your back, while turning your torso to one side, then straighten your back (increasing the distance between the fingers) and bring your pelvis, lumbar vertebrae, and sternum forward in succession. Imagine a wave starting at the top, moving downwards and then back up again, in the opposite direction. *2 min each side*

## Spine Tendons

5) Frontal waves

Position yourself four inches from a wall. Bring your nose, chin, sternum, navel, pelvis, and knees successively closer to the wall. Repeat the exercise, making a wave with your spine. *20 times*

6) Jefferson Curl

Stand on a step with a light dumbbell (start with 10 lb.) and keep your legs straight, shoulder-width apart. Round the neck, then the upper back, the middle, then the lumbar region, finishing with an anterior tilt of the pelvis.) Hold the stretch for a few seconds, then move up in the opposite order (pelvis, lower back, etc.), contracting your buttocks. For the demonstration, I'm doing the exercise on a chair, but for greater safety I recommend you use a step. *10x3 series*

## Back Stability

7) The boat
Lift your head and shoulder blades off the floor, arms stretched backwards, legs twenty centimeters off the floor.
*Until you're tired x 3 sets*

8) The free fall
Lie on your stomach in the parachutist position: legs bent, knees, head and chest off the ground, heels pushed towards the ceiling, arms in a "W", thumbs up.
*To fatigue x 3 sets*

*To prevent arching the back, you can place a small cushion under your belly or a tennis ball. The goal is to lift the navel upward to lift the belly off the ball as much as possible. Also, avoid lifting the chin as it is bad for the neck.*

9) Transition hollow, prone et lateral

On your stomach, turn sideways (only your pelvis, stomach and lower back are in contact with the floor during the exercise), then turn onto your back ("boat" position) and then onto the other side.

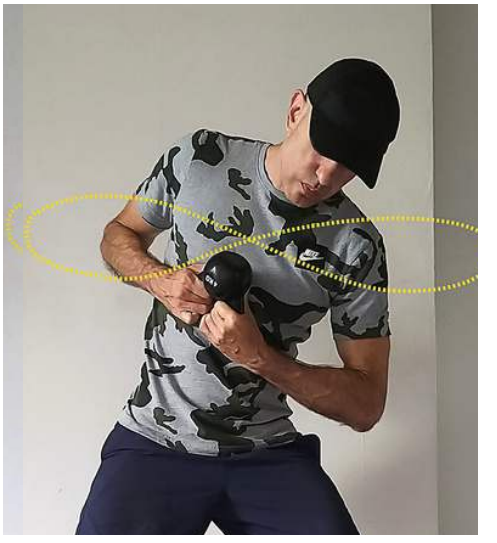
*6 times on each side x 3 sets*

10) The Breaststroke
Lie on a bench with your legs outstretched and extend one leg as far as possible back and to the side, toe out, while the other is bent like a breaststroke swimmer. Alternate one leg and then the other. This is an exercise for the glutes, but also excellent for the lower back.
*15 reps x 3 sets*

## Spinal Neuromotor Control

11) “8" movement with kettlebell
IIn sumo position, legs wide apart, pelvis in retroversion, hold a light kettlebell (13lb.) in front of your chest and make it describe horizontal "8s" by moving your trunk, pelvis fixed.

This exercise strengthens the back and at the same time teaches how to coordinate the different vertebral levels.
*6 in each direction, 2 sets*



# THE NECK

*Fortunately, serious neck problems are rarer than those affecting the lower back. There is, of course, the notorious "head forward" syndrome caused by working at a computer screen, but this is easily corrected by strengthening the deep neck flexors (chin tucking exercise).*
*Cervical hernias, which are very incapacitating, are mainly caused by driving accidents, trauma, or yoga postures with cranial support.*
*Strengthening the neck is important for surviving road accidents, but also for sport and combat. Itis often neglected in sports preparation, except in very specific sports (wrestling, boxing, Formula 1) which put particular demands on it.*

## Neck Cartilage

1) Jump Rope (prevention)
It sounds paradoxical, but if you don't have any neck pain or pathology, skipping will strengthen your neck if you take care to tuck your chin in and land softly on your toes. Skipping will also make you aware of any forward head posture.
*10 minutes*

2) Jumping on a trampoline (rehabilitation)
Tuck your chin in slightly if you have forward head syndrome and keep your gaze horizontal.
*10 minutes*

## Neck Capsule and Ligaments

3) Mobilization with yoga strap / belt / towel
Fold a large towel into a triangle (or use a strap as shown in the photo) and loop it around your head. Gently pulling on each end, rotate your head as far as it will go and hold the stretch for six deep breaths.

4) Segmental strengthening with elastics
With a light elastic band at the back of your neck, pull your neck back while resisting the band, chin slightly tucked in. Repeat, moving the elastic to mobilize another cervical level.
*Repeat 10 times*

5) Overall conditioning
With an elastic band at head height, attached to a strap, resist statically, first from the front, then from the side and finally from the back. Remember to tuck your chin in slightly and don't apply too much tension. In this image, I'm using an ab suspension strap, but a towel would also work.
*30 seconds on each side*

## Neck Stability

6) Neck board against a wall
Stand with your back against a wall, your heels about eight inches from the wall. Slip a towel between your occiput and the wall and hold on tight, tucking your chin in slightly. You can increase the difficulty of this exercise by using a basketball instead of a towel, but in this case it's better to kneel.

*2 times for one minute*

7) Rapid side bends with gourd filled with sand
Fill 2/3 of a large gourd (or even better 2) with water or sand. Place it against your head and perform rapid lateral tilts for one minute. This strengthen the neck tendons and muscles especially because of the impacts.

## Neuromotor Control of the Neck

8) Strengthening the deep neck flexors
Lying on your back, lift your head slightly for 5 seconds, keeping your chin tucked in (just long enough to remove a sheet of paper placed between your head and the floor).
*12 repetitions x 2 sets*

8) 360° strengthening with ball
Place a slightly deflated basketball between your forehead and a wall. Letting yourself fall forward while controlling the pressure of your arms, move your head a few centimeters in different directions: flexion, extension, lateral tilt, and rotation.
About ten short movements on each side. Be careful not to put too much pressure on the neck, especially at first. *3 min*

# THE ELBOW

*The elbow is a solid joint that can become the site of tendon pain (tennis elbow, golfer's elbow, etc.) or osteoarthritis. The cartilage suffers when it catches a fall, but it is also very much in demand in sports such as boxing, where working with the bag puts it to a severe test and it is common to accidentally hyperextend the elbow and miss your target. As with the shoulders, hanging from a bar, keeping your feet on the ground, and alternately turning the hollow of the elbow inwards and then outwards, is particularly effective as it decompresses the elbow and distracts (pulls) the radius.*

## Elbow Cartilage

1) Multidirectional elbow extensions
With a rubberband held over your head, perform rapid downward extensions of the elbow, then diagonally to the sides.
*100 repetitions*

2) Elbow distraction (opening) with ball
Take hold of a rubber band fixed high up and place a tennis ball in the hollow of your neck. Hold this position with your arm pulled back. The ball placed between the forearm and the humerus will relax the elbow capsule.
*2 minutes*

3) Elbow pulses
Lying on your back, grasp a rubber band attached to a light weight (2-3 kg) and perform low- amplitude, pulsed elbow extensions.
*40 reps x 2 sets*

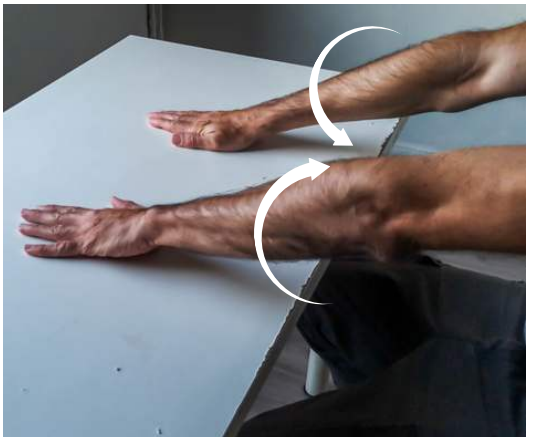
## Elbow Capsule and Ligaments

4) Elbow rotations in passive suspension
Hang from a bar, keeping your feet on the ground, and rotate the hollow of your elbow outwards, then inwards, with your arms outstretched.
*Perform one set of 2 minutes.*

## Elbow Tendons

5) Locking the elbow in extension
On all fours, with your arm bent, place a rubber band in the crease of your elbow, with the other end fixed at your side, and straighten your arm, resisting the tension of the rubber band. *15 reps x 3 series*

6) Ulnar-radial rotation on a table
With your arms straight and your hands resting on a table, turn the inside of your elbow outwards as far as possible, keeping your hands flat. To do this, press firmly on the inside of your hands, as if you were pronating isometrically against the resistance of the table. Then do the opposite: turn the hollow of the elbow inwards, pressing the outside of the hand against the table.
*15 reps x 2 sets*



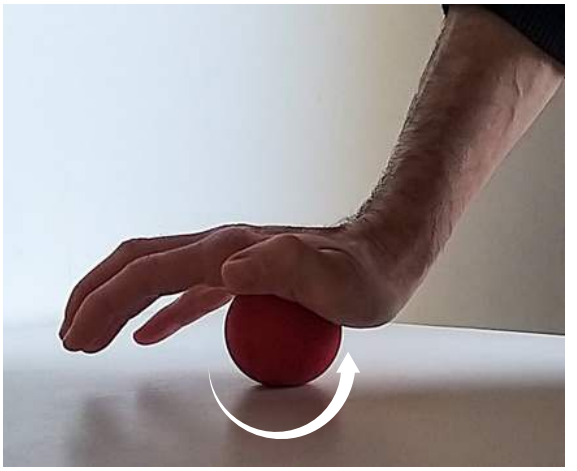
*N.B. Rotations with a hammer, shown in the "wrist" section, are also excellent for elbow health.*

## Elbow Stability

7) Pronation and supination with kettlebell held upside down
Grasp a kettlebell upside down, elbow to body, and turn your forearm in pronation and supination ten times (you can also do this exercise while walking to increase the challenge). *15 repetitions x 3 sets*



## Neuromotor Control of the Elbow



8) Palm massage
On all fours, place a Lacrosse Ball under the palm of your hand and roll it while applying moderate pressure.This will relieve elbow pain. Like the plantar fascia, the palmar fascia needs to be "de-fibrosed". *2 minutes*

# PROGRAM OVERVIEW

## IDENTIFY YOUR GOAL

**GOAL 1**
**UNBREAKABLE**
**Option HEALTH**

I don't have any serious joint issue.
I would mainly like to learn how to strengthen my body to avoid injuries in the future.
I prioritize health over performance

**GOAL 2**
**UNBREAKABLE**
**Option PERFORMANCE**

My joints are currently fine. I aim to be as performant as possible. Injury is a risk, but we can't always avoid it when we give it all.

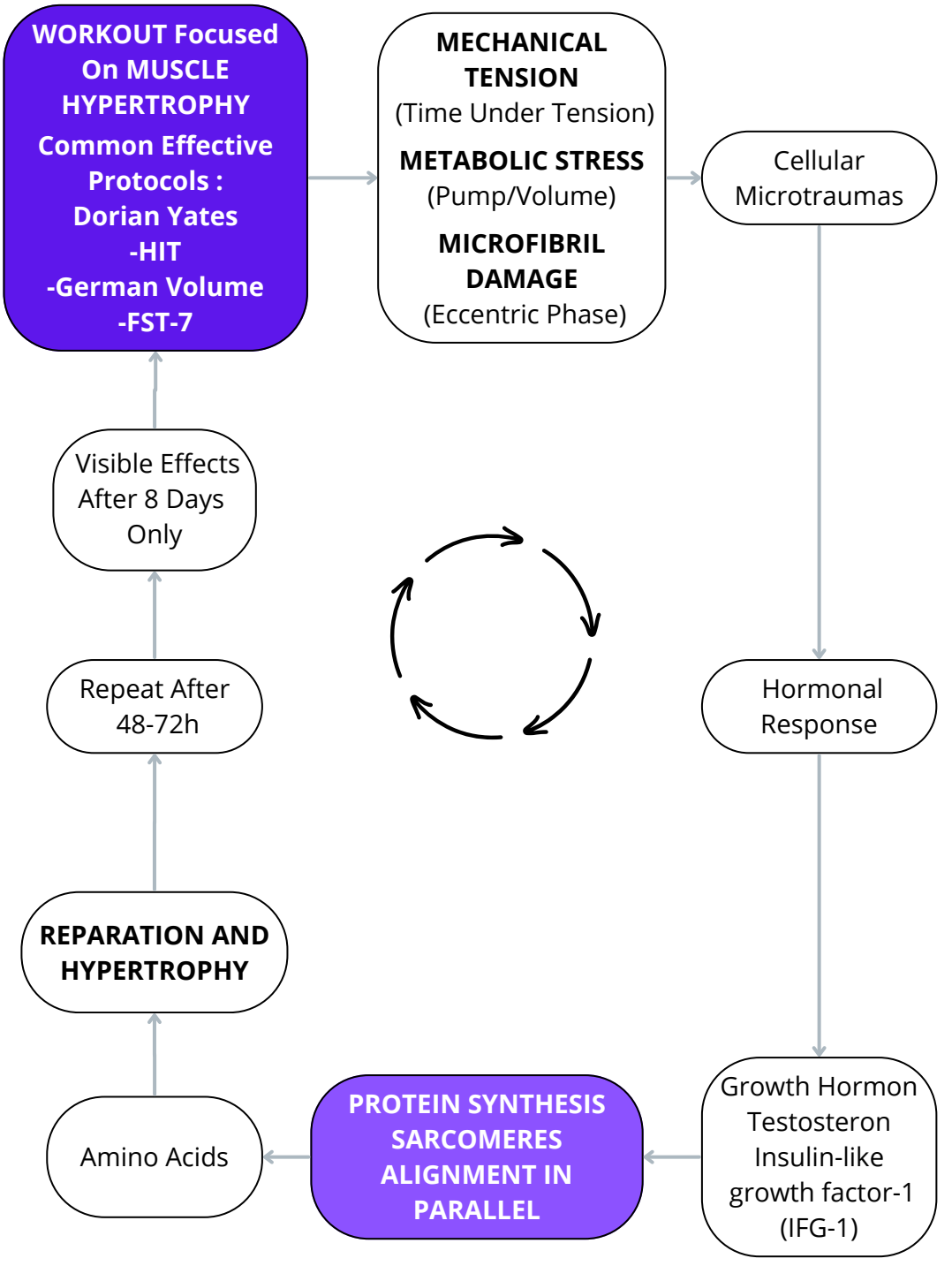
**GOAL 3**
**UNBREAKABLE**
**Option PHENIX**

Some of my past injuries never fully healed, and I would do everything to get back on top and regain the shape of my prime

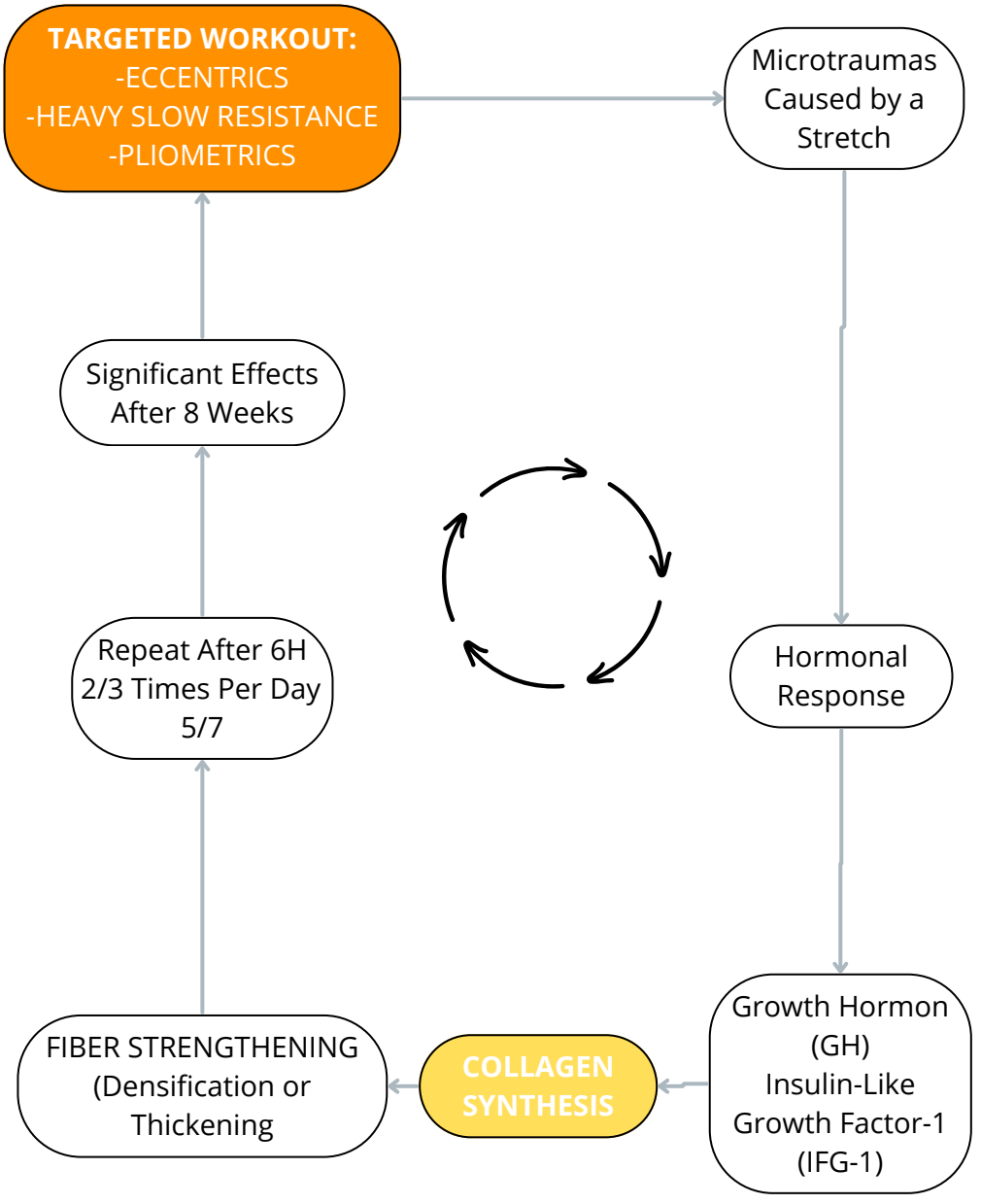
**GOAL 4**
**UNBREAKABLE**
**Option LONGEVITY**

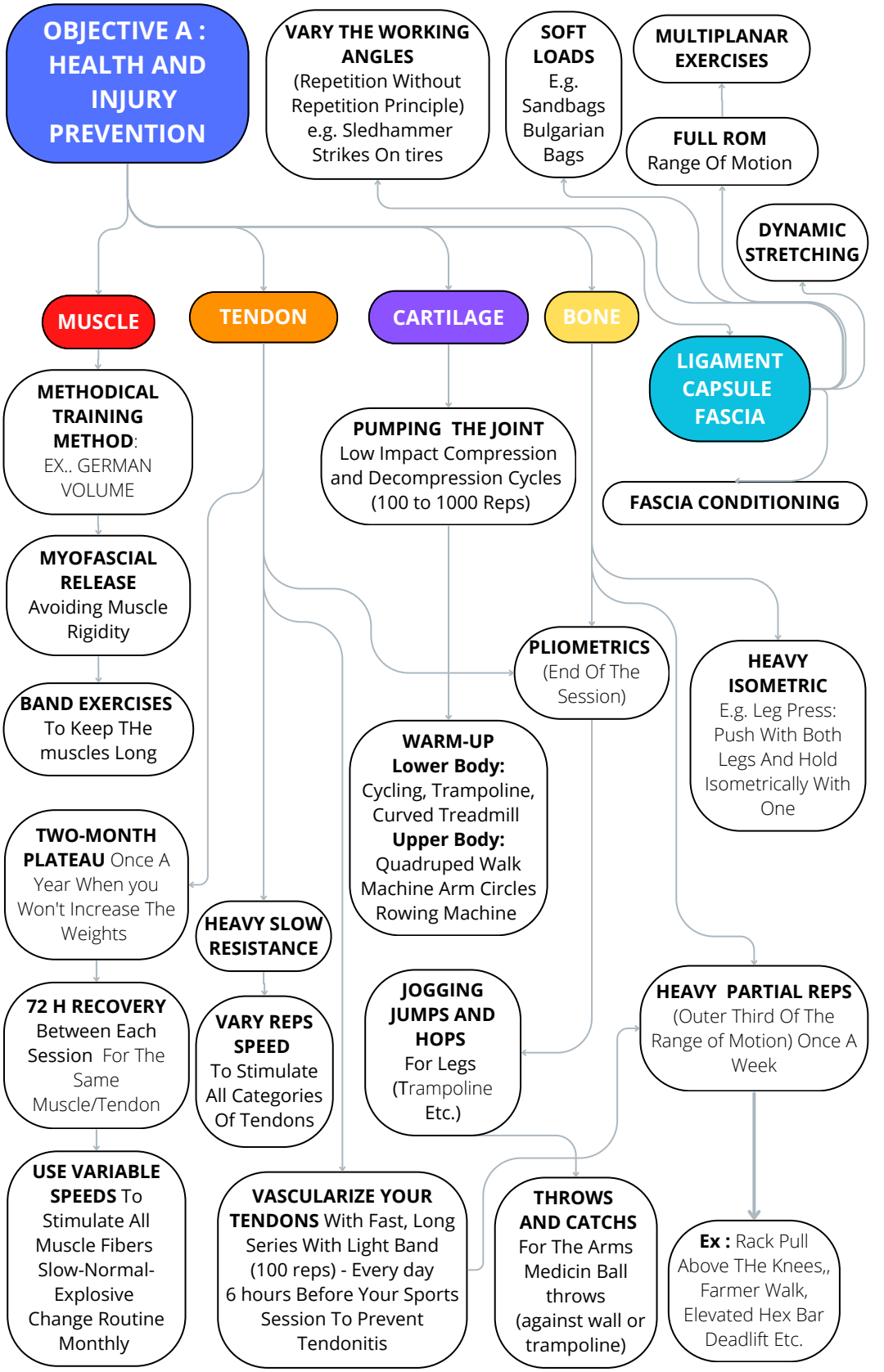
I want to extend my athletic longevity as much as possible and take care of my cranky joints while minimizing risks

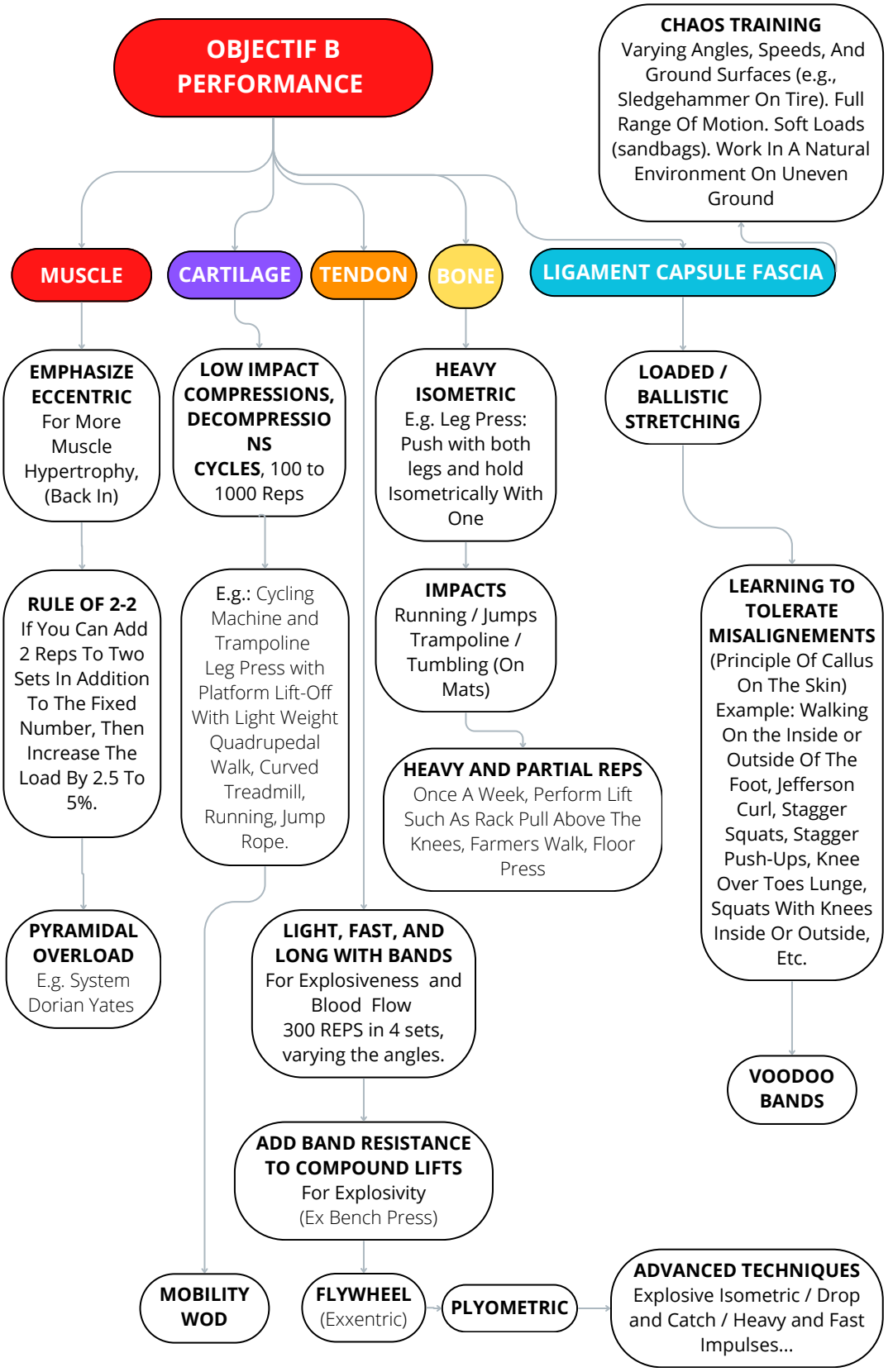
# MUSCLE HYPERTROPHY CYCLE

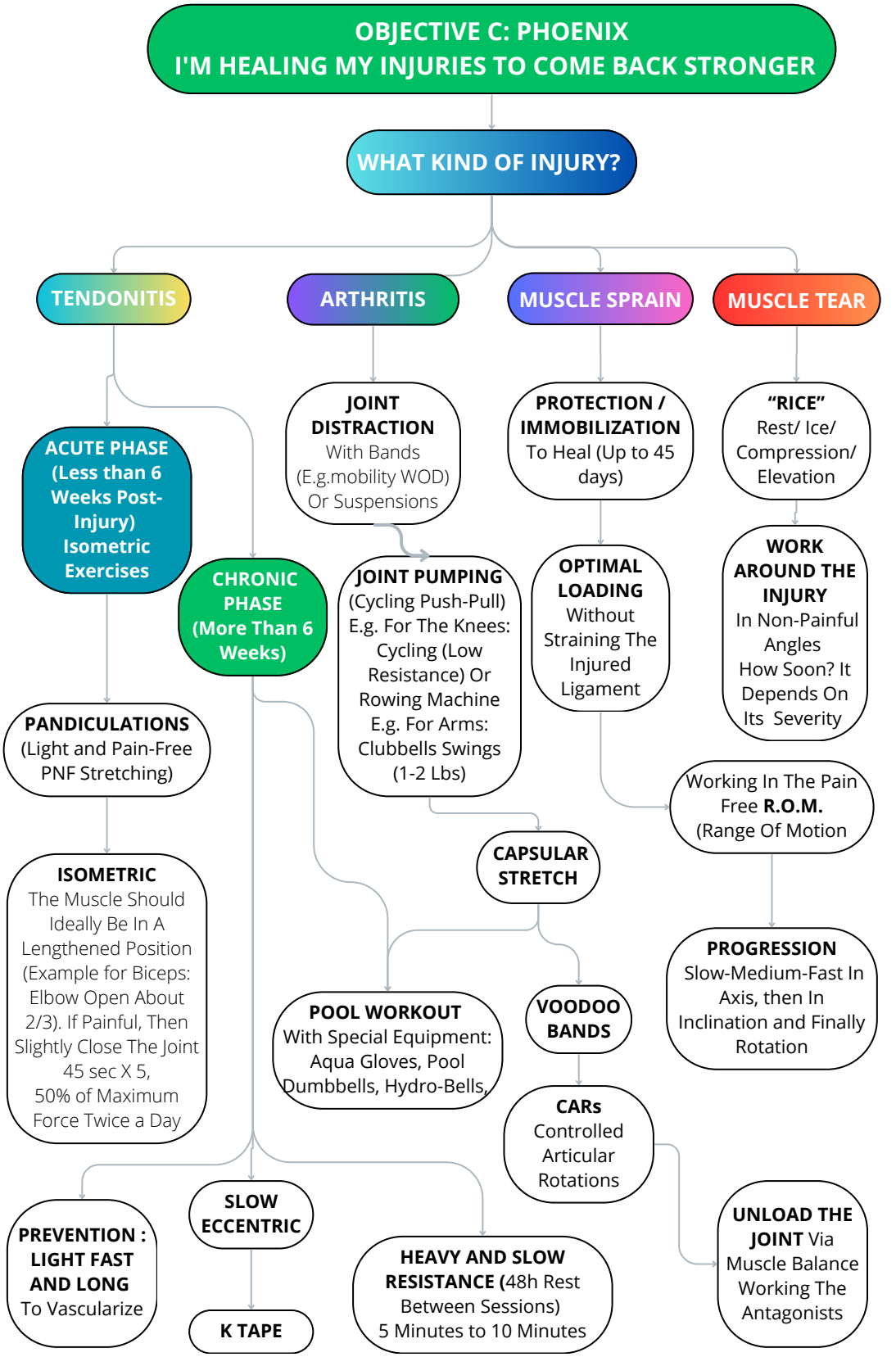


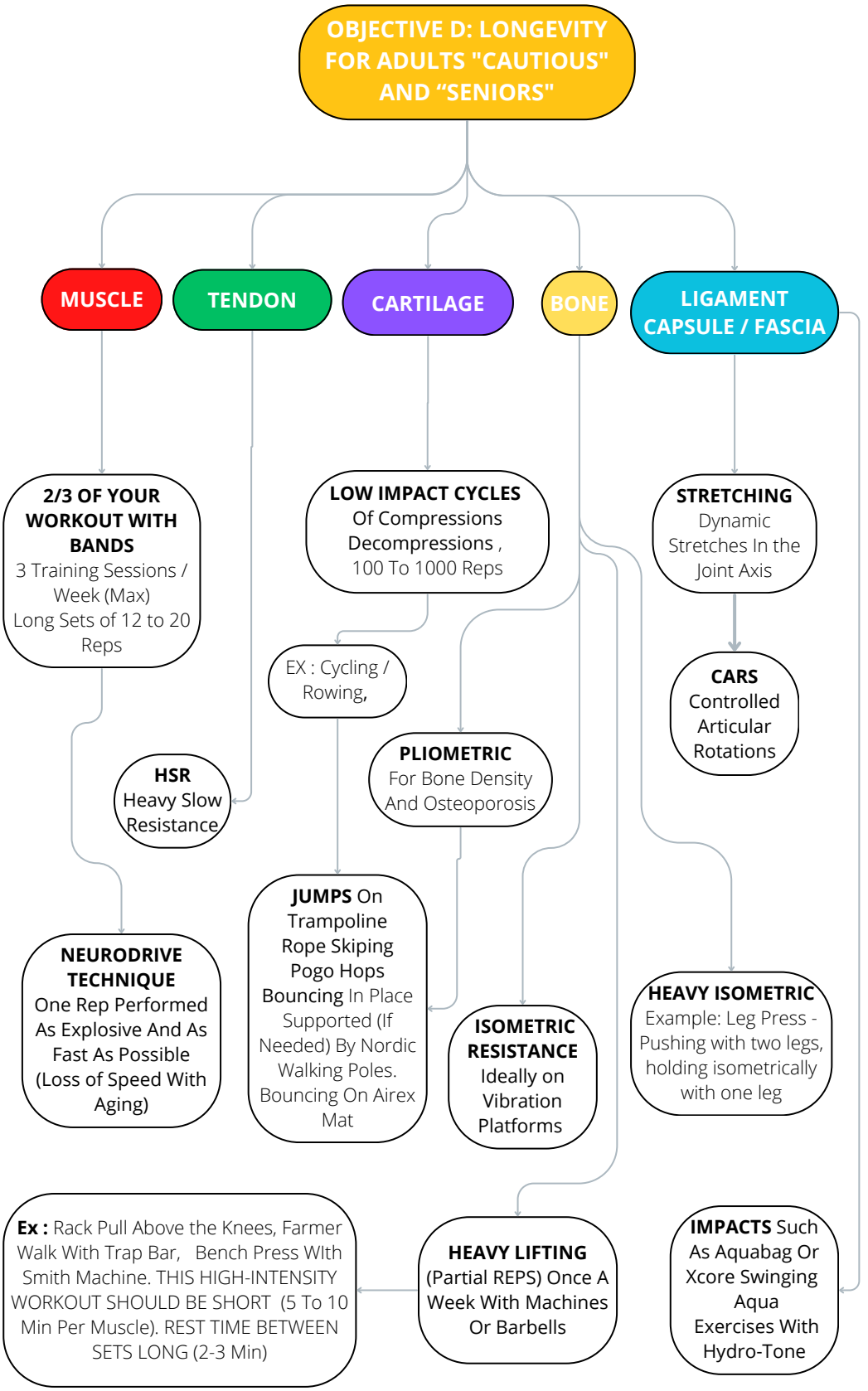
# CYCLE OF DENSIFICATION FOR SOFT TISSUES (TENDON/LIGAMENT)

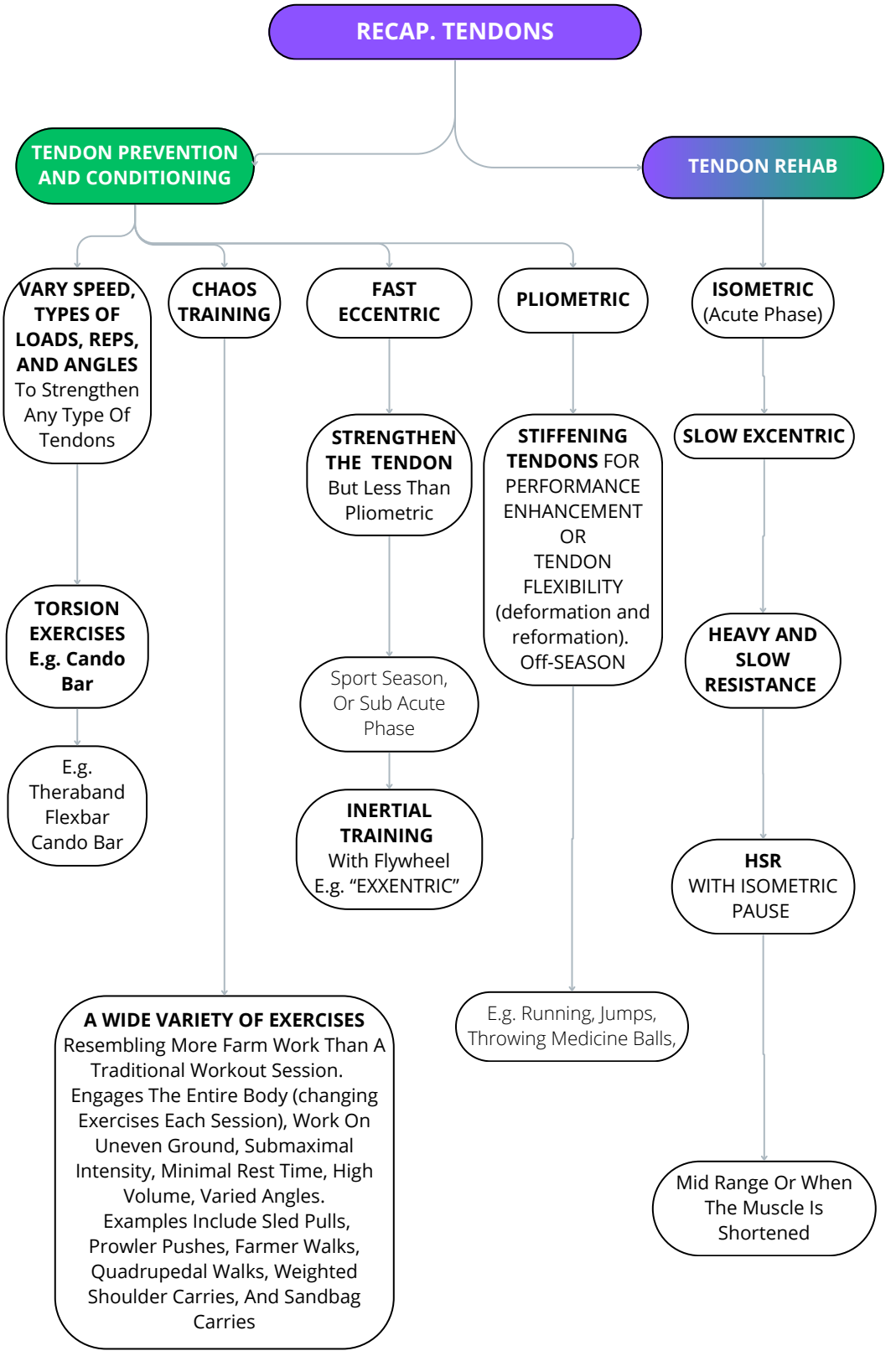


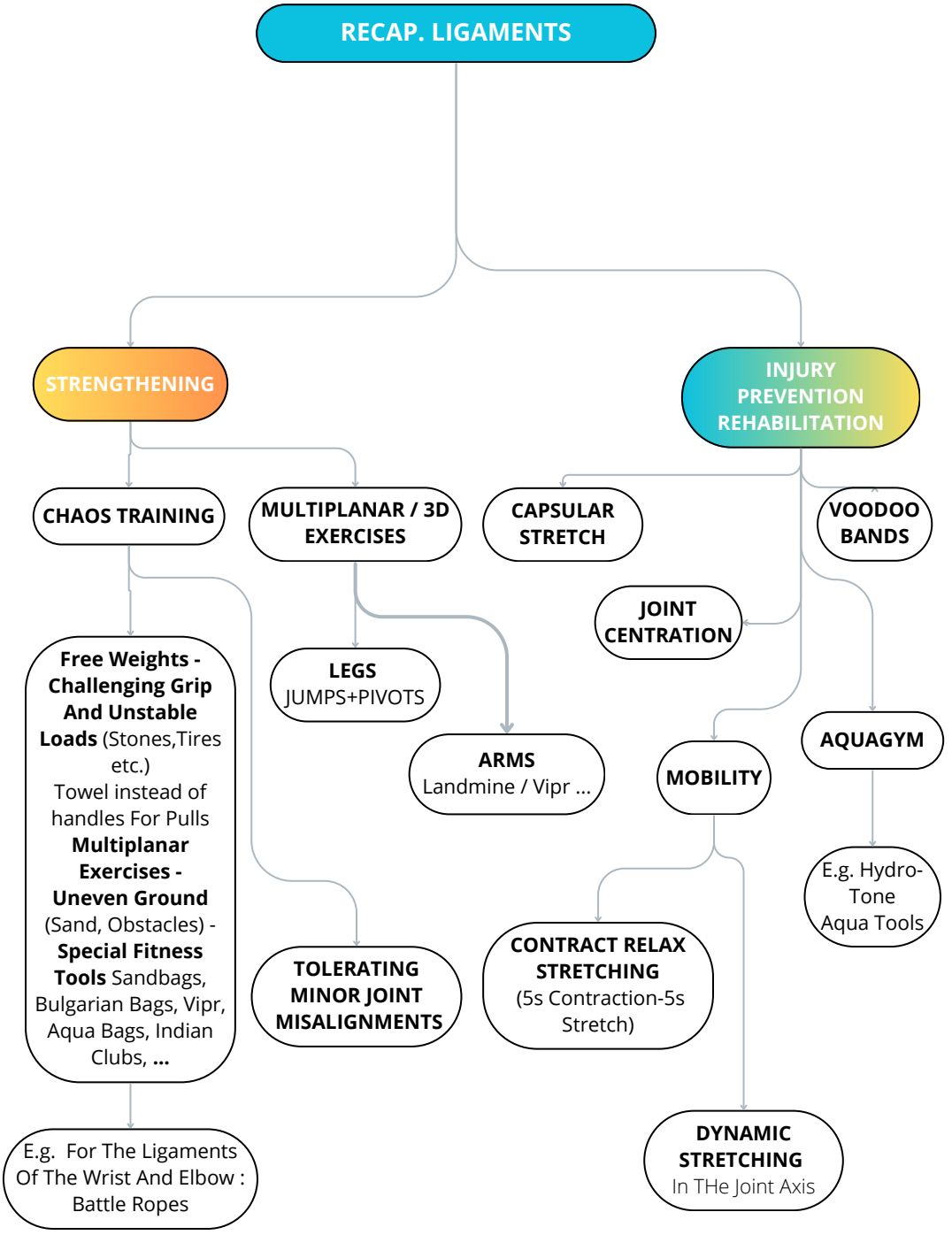

OBJECTIVE A : HEALTH AND INJURY PREVENTION
VARY THE WORKING ANGLES (Repetition Without Repetition Principle) e.g. Sledhammer Strikes On tires
SOFT LOADS E.g. Sandbags Bulgarian Bags
MULTIPLANAR EXERCISES
FULL ROM Range Of Motion
DYNAMIC STRETCHING
MUSCLE
TENDON
CARTILAGE
BONE
LIGAMENT CAPSULE FASCIA
METHODICAL TRAINING METHOD: EX.. GERMAN VOLUME
PUMPING THE JOINT Low Impact Compression and Decompression Cycles (100 to 1000 Reps)
FASCIA CONDITIONING
MYOFASCIAL RELEASE Avoiding Muscle Rigidity
PLIOMETRICS (End Of The Session)
HEAVY ISOMETRIC E.g. Leg Press: Push With Both Legs And Hold Isometrically With One
BAND EXERCISES To Keep THe muscles Long
WARM-UP Lower Body: Cycling, Trampoline, Curved Treadmill Upper Body: Quadruped Walk Machine Arm Circles Rowing Machine
TWO-MONTH PLATEAU Once A Year When you Won't Increase The Weights
HEAVY SLOW RESISTANCE
JOGGING JUMPS AND HOPS For Legs (Trampoline Etc.)
HEAVY PARTIAL REPS (Outer Third Of The Range of Motion) Once A Week
72 H RECOVERY Between Each Session For The Same Muscle/Tendon
VARY REPS SPEED To Stimulate All Categories Of Tendons
USE VARIABLE SPEEDS To Stimulate All Muscle Fibers Slow-Normal-Explosive Change Routine Monthly
VASCULARIZE YOUR TENDONS With Fast, Long Series With Light Band (100 reps) - Every day 6 hours Before Your Sports Session To Prevent Tendonitis
THROWS AND CATCHS For The Arms Medicin Ball throws (against wall or trampoline)
Ex : Rack Pull Above THe Knees,, Farmer Walk, Elevated Hex Bar Deadlift Etc.

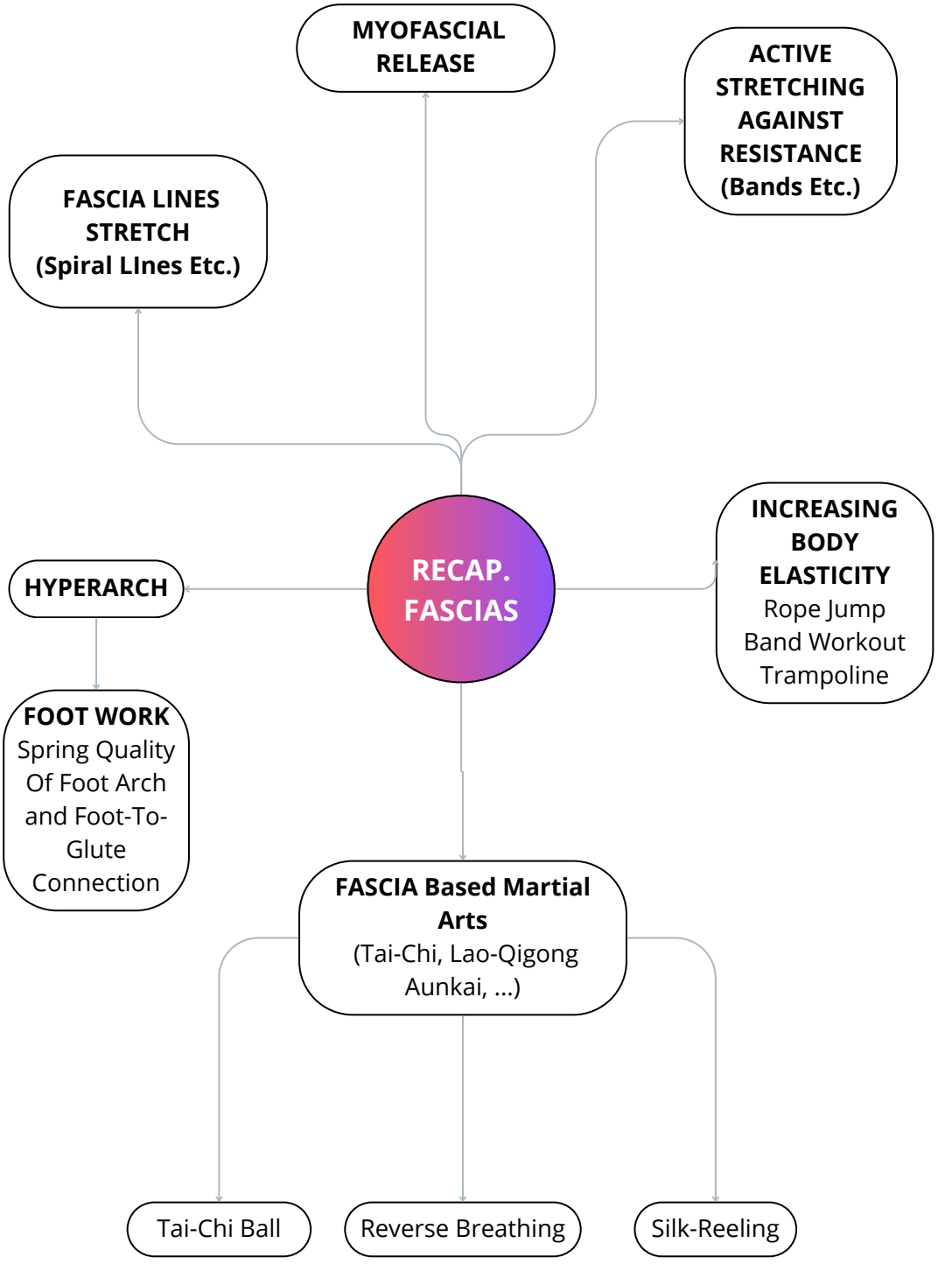

OBJECTIF B PERFORMANCE
CHAOS TRAINING
Varying Angles, Speeds, And Ground Surfaces (e.g., Sledgehammer On Tire). Full Range Of Motion. Soft Loads (sandbags). Work In A Natural Environment On Uneven Ground
MUSCLE
CARTILAGE
TENDON
BONE
LIGAMENT CAPSULE FASCIA
EMPHASIZE ECCENTRIC For More Muscle Hypertrophy, (Back In)
LOW IMPACT COMPRESSIONS, DECOMPRESSIONS CYCLES, 100 to 1000 Reps
HEAVY ISOMETRIC E.g. Leg Press: Push with both legs and hold Isometrically With One
LOADED / BALLISTIC STRETCHING
RULE OF 2-2 If You Can Add 2 Reps To Two Sets In Addition To The Fixed Number, Then Increase The Load By 2.5 To 5%.
E.g.: Cycling Machine and Trampoline Leg Press with Platform Lift-Off With Light Weight Quadrupedal Walk, Curved Treadmill, Running, Jump Rope.
IMPACTS Running / Jumps Trampoline / Tumbling (On Mats)
LEARNING TO TOLERATE MISALIGNEMENTS (Principle Of Callus On The Skin) Example: Walking On the Inside or Outside Of The Foot, Jefferson Curl, Stagger Squats, Stagger Push-Ups, Knee Over Toes Lunge, Squats With Knees Inside Or Outside, Etc.
HEAVY AND PARTIAL REPS Once A Week, Perform Lift Such As Rack Pull Above The Knees, Farmers Walk, Floor Press
PYRAMIDAL OVERLOAD E.g. System Dorian Yates
LIGHT, FAST, AND LONG WITH BANDS For Explosiveness and Blood Flow 300 REPS in 4 sets, varying the angles.
VOODOO BANDS
ADD BAND RESISTANCE TO COMPOUND LIFTS For Explosivity (Ex Bench Press)
MOBILITY WOD
FLYWHEEL (Exxentric)
PLYOMETRIC
ADVANCED TECHNIQUES Explosive Isometric / Drop and Catch / Heavy and Fast Impulses...

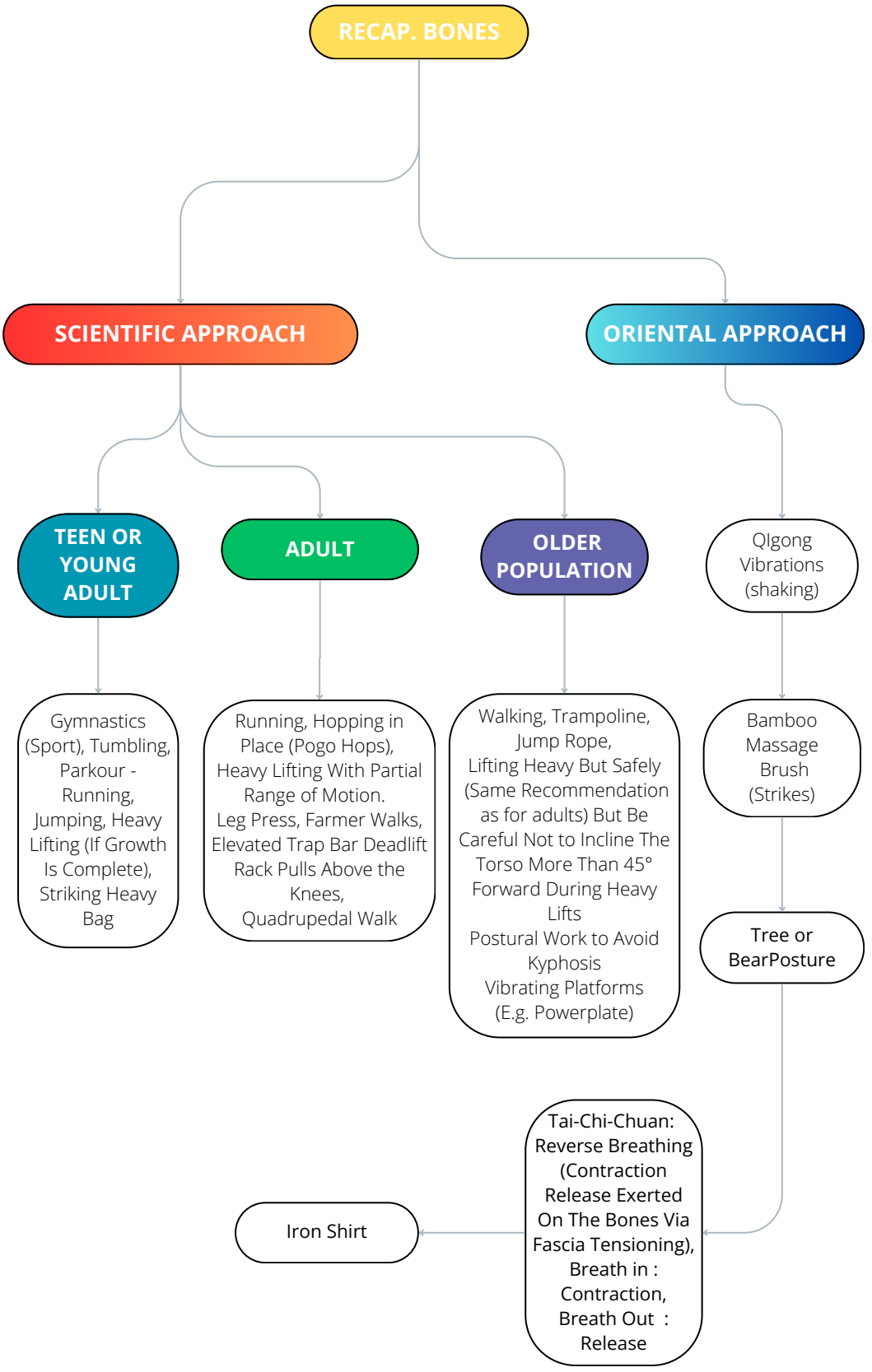

OBJECTIVE C: PHOENIX
I'M HEALING MY INJURIES TO COME BACK STRONGER
WHAT KIND OF INJURY?
TENDONITIS
ARTHRITIS
MUSCLE SPRAIN
MUSCLE TEAR
ACUTE PHASE (Less than 6 Weeks Post-Injury) Isometric Exercises
CHRONIC PHASE (More Than 6 Weeks)
JOINT DISTRACTION With Bands (E.g.mobility WOD) Or Suspensions
PROTECTION / IMMOBILIZATION To Heal (Up to 45 days)
"RICE" Rest/ Ice/ Compression/ Elevation
WORK AROUND THE INJURY In Non-Painful Angles How Soon? It Depends On Its Severity
JOINT PUMPING (Cycling Push-Pull) E.g. For The Knees: Cycling (Low Resistance) Or Rowing Machine E.g. For Arms: Clubbells Swings (1-2 Lbs)
OPTIMAL LOADING Without Straining The Injured Ligament
PANDICULATIONS (Light and Pain-Free PNF Stretching)
Working In The Pain Free R.O.M. (Range Of Motion
CAPSULAR STRETCH
ISOMETRIC The Muscle Should Ideally Be In A Lengthened Position (Example for Biceps: Elbow Open About 2/3). If Painful, Then Slightly Close The Joint 45 sec X 5, 50% of Maximum Force Twice a Day
PROGRESSION Slow-Medium-Fast In Axis, then In Inclination and Finally Rotation
POOL WORKOUT With Special Equipment: Aqua Gloves, Pool Dumbbells, Hydro-Bells,
VOODOO BANDS
CARs Controlled Articular Rotations
PREVENTION : LIGHT FAST AND LONG To Vascularize
SLOW ECCENTRIC
K TAPE
HEAVY AND SLOW RESISTANCE (48h Rest Between Sessions) 5 Minutes to 10 Minutes
UNLOAD THE JOINT Via Muscle Balance Working The Antagonists

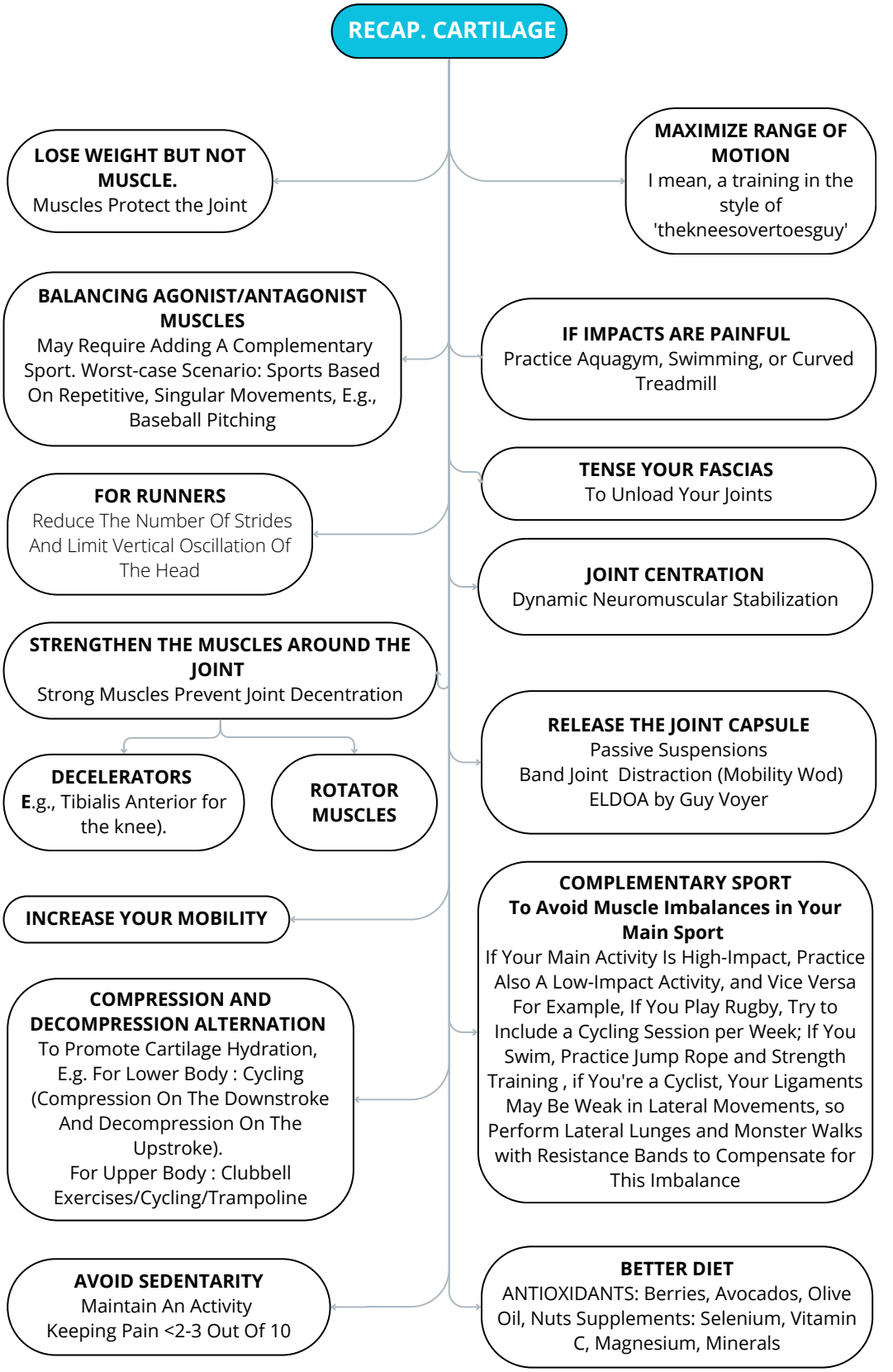

OBJECTIVE D: LONGEVITY FOR ADULTS "CAUTIOUS" AND “SENIORS"
MUSCLE
TENDON
CARTILAGE
BONE
LIGAMENT CAPSULE / FASCIA
2/3 OF YOUR WORKOUT WITH BANDS
3 Training Sessions / Week (Max)
Long Sets of 12 to 20 Reps
LOW IMPACT CYCLES
Of Compressions Decompressions , 100 To 1000 Reps
STRETCHING
Dynamic Stretches In the Joint Axis
EX : Cycling / Rowing,
CARS
Controlled Articular Rotations
HSR
Heavy Slow Resistance
PLIOMETRIC
For Bone Density And Osteoporosis
NEURODRIVE TECHNIQUE
One Rep Performed As Explosive And As Fast As Possible (Loss of Speed With Aging)
JUMPS On Trampoline Rope Skiping Pogo Hops Bouncing In Place Supported (If Needed) By Nordic Walking Poles. Bouncing On Airex Mat
ISOMETRIC RESISTANCE
Ideally on Vibration Platforms
HEAVY ISOMETRIC
Example: Leg Press - Pushing with two legs, holding isometrically with one leg
Ex : Rack Pull Above the Knees, Farmer Walk With Trap Bar, Bench Press WIth Smith Machine. THIS HIGH-INTENSITY WORKOUT SHOULD BE SHORT (5 To 10 Min Per Muscle). REST TIME BETWEEN SETS LONG (2-3 Min)
HEAVY LIFTING
(Partial REPS) Once A Week With Machines Or Barbells
IMPACTS Such As Aquabag Or Xcore Swinging Aqua Exercises With Hydro-Tone

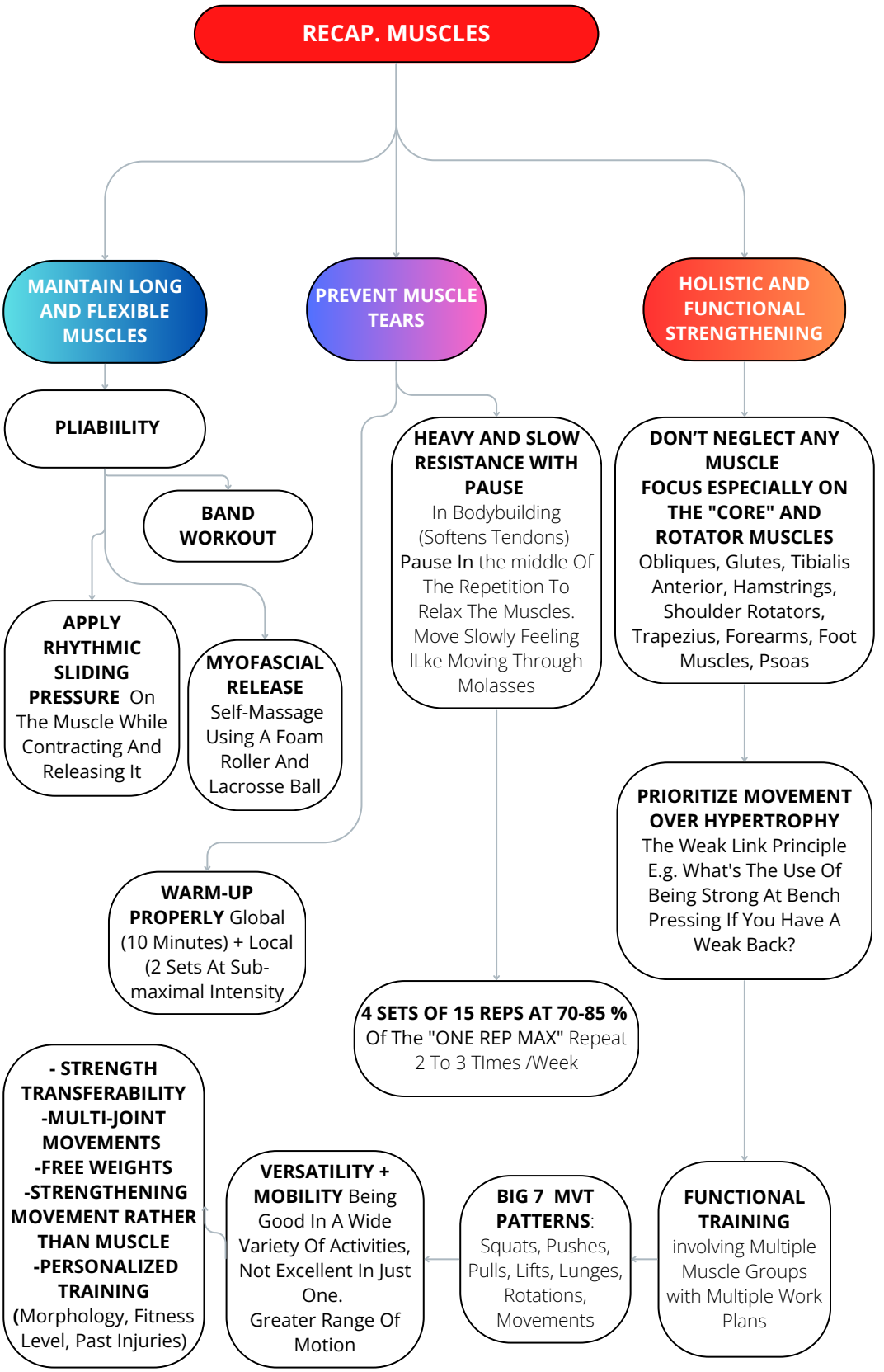

RECAP. TENDONS
TENDON PREVENTION AND CONDITIONING
TENDON REHAB
VARY SPEED, TYPES OF LOADS, REPS, AND ANGLES To Strengthen Any Type Of Tendons
CHAOS TRAINING
FAST ECCENTRIC
PLIOMETRIC
ISOMETRIC (Acute Phase)
STRENGTHEN THE TENDON But Less Than Pliometric
STIFFENING TENDONS FOR PERFORMANCE ENHANCEMENT OR TENDON FLEXIBILITY (deformation and reformation). Off-SEASON
SLOW EXCENTRIC
TORSION EXERCISES E.g. Cando Bar
E.g. Theraband Flexbar Cando Bar
Sport Season, Or Sub Acute Phase
INERTIAL TRAINING With Flywheel E.g. "EXXENTRIC"
HEAVY AND SLOW RESISTANCE
HSR WITH ISOMETRIC PAUSE
A WIDE VARIETY OF EXERCISES Resembling More Farm Work Than A Traditional Workout Session. Engages The Entire Body (changing Exercises Each Session), Work On Uneven Ground, Submaximal Intensity, Minimal Rest Time, High Volume, Varied Angles. Examples Include Sled Pulls, Prowler Pushes, Farmer Walks, Quadrupedal Walks, Weighted Shoulder Carries, And Sandbag Carries
E.g. Running, Jumps, Throwing Medicine Balls,
Mid Range Or When The Muscle Is Shortened

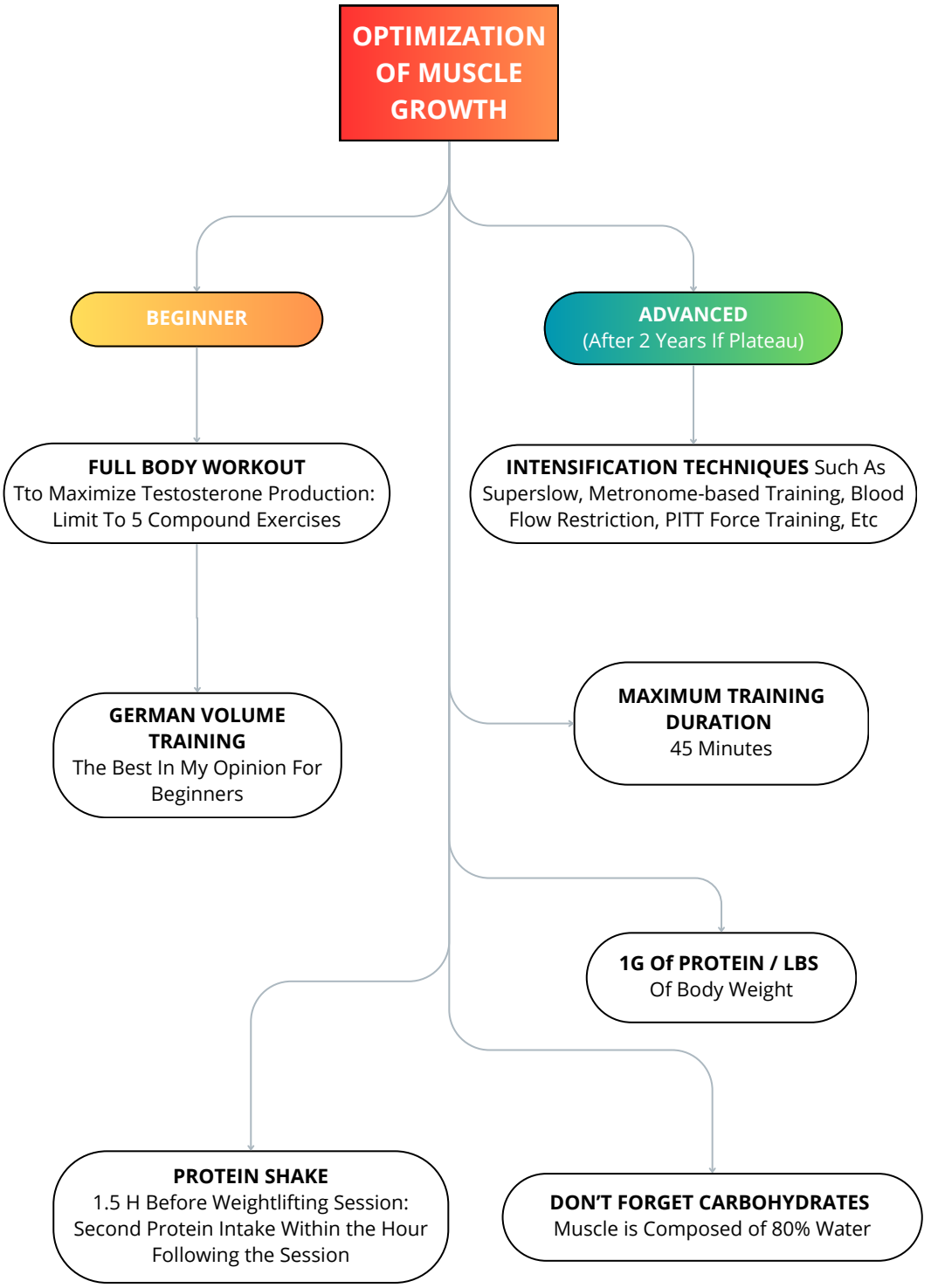

RECAP. LIGAMENTS
STRENGTHENING
INJURY PREVENTION REHABILITATION
CHAOS TRAINING
MULTIPLANAR / 3D EXERCISES
CAPSULAR STRETCH
VOODOO BANDS
JOINT CENTRATION
Free Weights - Challenging Grip And Unstable Loads (Stones,Tires etc.)
Towel instead of handles For Pulls
Multiplanar Exercises - Uneven Ground
(Sand, Obstacles) -
Special Fitness Tools Sandbags, Bulgarian Bags, Vipr, Aqua Bags, Indian Clubs, ...
LEGS
JUMPS+PIVOTS
ARMS
Landmine / Vipr ...
MOBILITY
AQUAGYM
E.g. Hydro-Tone Aqua Tools
TOLERATING MINOR JOINT MISALIGNMENTS
CONTRACT RELAX STRETCHING
(5s Contraction-5s Stretch)
E.g. For The Ligaments Of The Wrist And Elbow : Battle Ropes
DYNAMIC STRETCHING
In THe Joint Axis

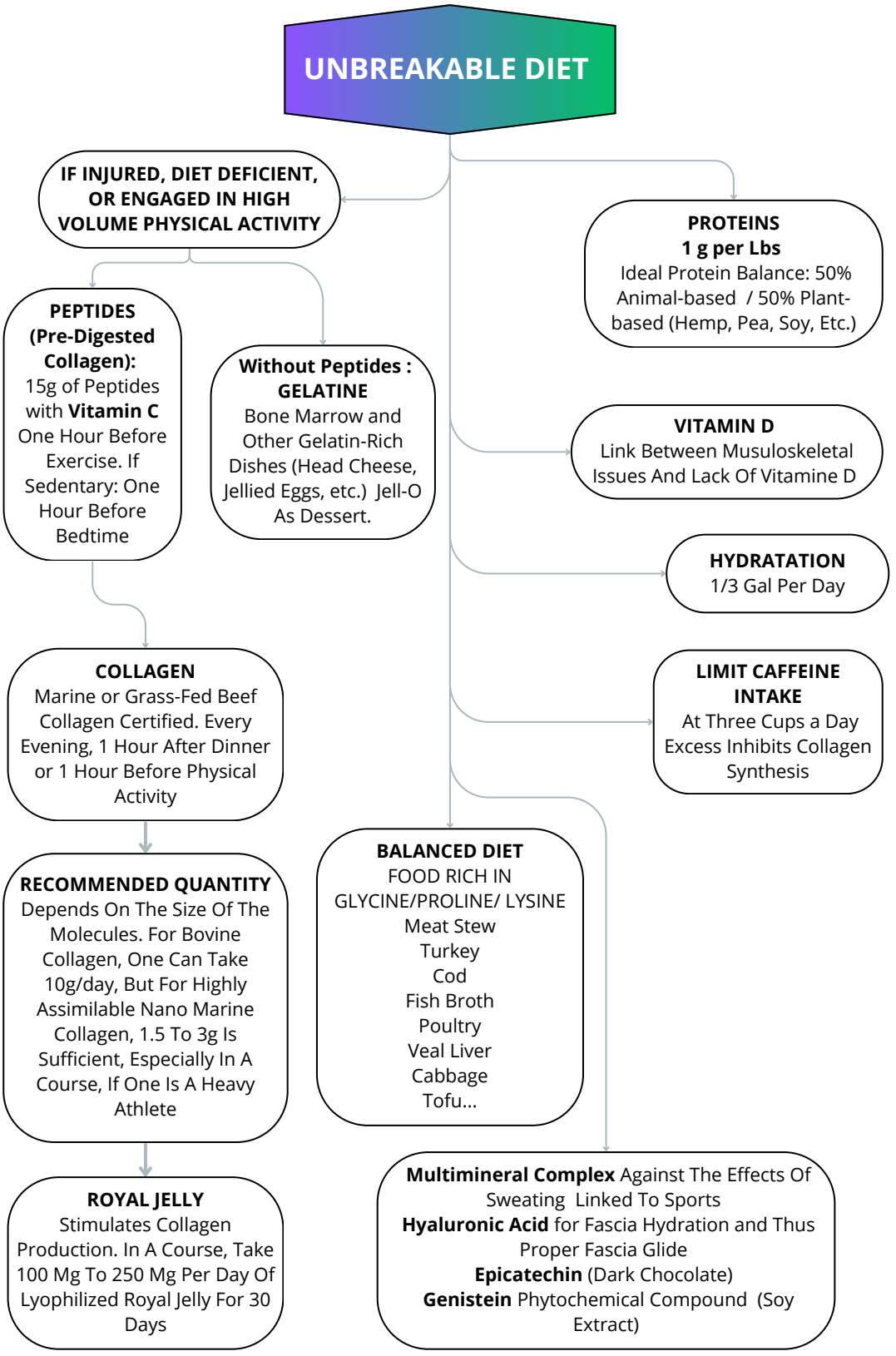

MYOFASCIAL RELEASE
ACTIVE STRETCHING AGAINST RESISTANCE (Bands Etc.)
FASCIA LINES STRETCH (Spiral LIne Etc.)
RECAP. FASCIAS
HYPERARCH
INCREASING BODY ELASTICITY
Rope Jump
Band Workout
Trampoline
FOOT WORK
Spring Quality Of Foot Arch and Foot-To-Glute Connection
FASCIA Based Martial Arts
(Tai-Chi, Lao-Qigong Aunkai, ...)
Tai-Chi Ball
Reverse Breathing
Silk-Reeling

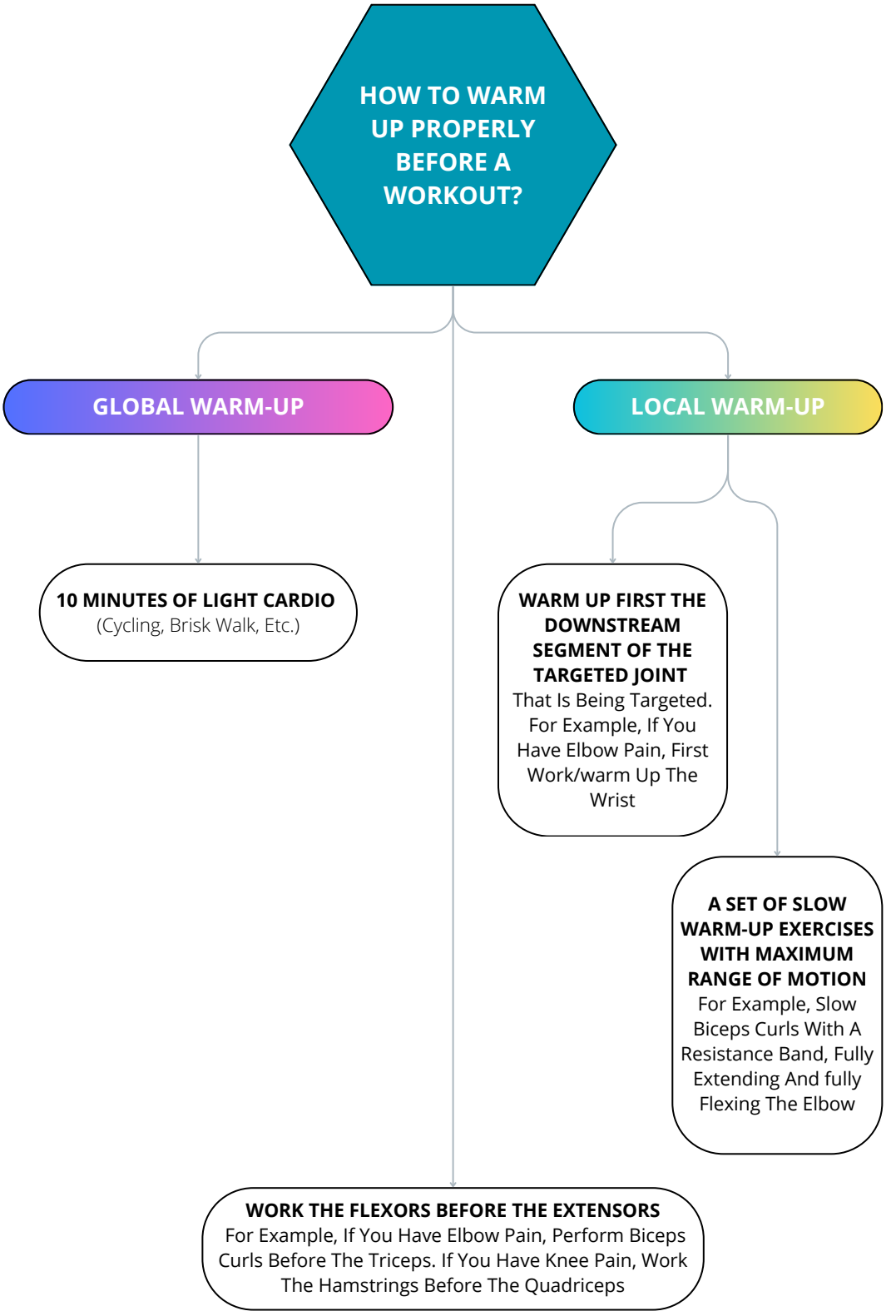

RECAP. BONES
SCIENTIFIC APPROACH
ORIENTAL APPROACH
TEEN OR YOUNG ADULT
ADULT
OLDER POPULATION
Qlgong Vibrations (shaking)
Gymnastics (Sport), Tumbling, Parkour - Running, Jumping, Heavy Lifting (If Growth Is Complete), Striking Heavy Bag
Running, Hopping in Place (Pogo Hops), Heavy Lifting With Partial Range of Motion. Leg Press, Farmer Walks, Elevated Trap Bar Deadlift Rack Pulls Above the Knees, Quadrupedal Walk
Walking, Trampoline, Jump Rope, Lifting Heavy But Safely (Same Recommendation as for adults) But Be Careful Not to Incline The Torso More Than 45° Forward During Heavy Lifts Postural Work to Avoid Kyphosis Vibrating Platforms (E.g. Powerplate)
Bamboo Massage Brush (Strikes)
Tree or BearPosture
Tai-Chi-Chuan: Reverse Breathing (Contraction Release Exerted On The Bones Via Fascia Tensioning), Breath in : Contraction, Breath Out : Release
Iron Shirt

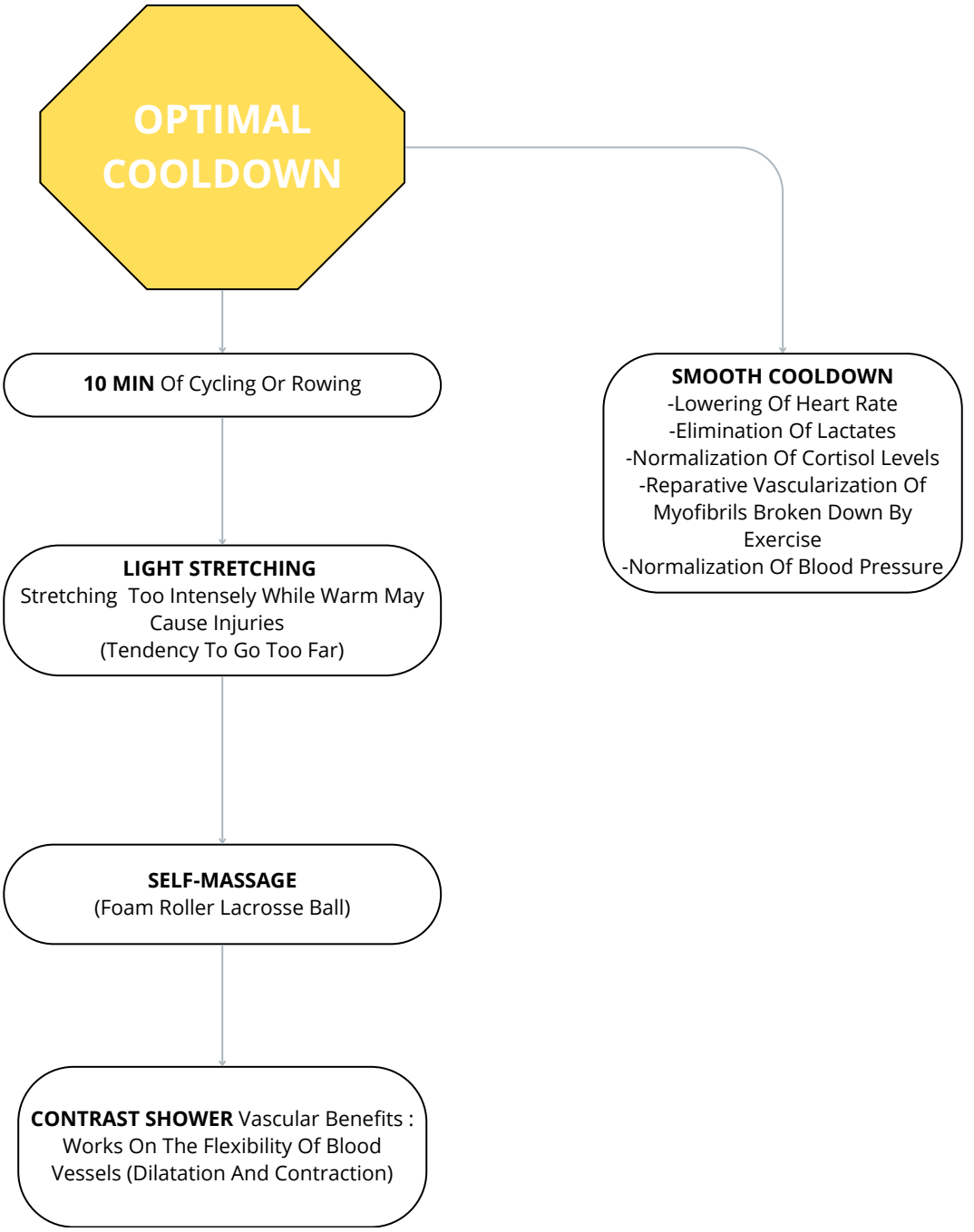

RECAP. CARTILAGE
LOSE WEIGHT BUT NOT MUSCLE.
Muscles Protect the Joint
MAXIMIZE RANGE OF MOTION
I mean, a training in the style of 'thekneesovertoesguy'
BALANCING AGONIST/ANTAGONIST MUSCLES
May Require Adding A Complementary Sport. Worst-case Scenario: Sports Based On Repetitive, Singular Movements, E.g., Baseball Pitching
IF IMPACTS ARE PAINFUL
Practice Aquagym, Swimming, or Curved Treadmill
TENSE YOUR FASCIAS
To Unload Your Joints
FOR RUNNERS
Reduce The Number Of Strides And Limit Vertical Oscillation Of The Head
JOINT CENTRATION
Dynamic Neuromuscular Stabilization
STRENGTHEN THE MUSCLES AROUND THE JOINT
Strong Muscles Prevent Joint Decentration
DECELERATORS
E.g., Tibialis Anterior for the knee).
ROTATOR MUSCLES
RELEASE THE JOINT CAPSULE
Passive Suspensions
Band Joint Distraction (Mobility Wod)
ELDOA by Guy Voyer
INCREASE YOUR MOBILITY
COMPLEMENTARY SPORT
To Avoid Muscle Imbalances in Your Main Sport
If Your Main Activity Is High-Impact, Practice Also A Low-Impact Activity, and Vice Versa For Example, If You Play Rugby, Try to Include a Cycling Session per Week; If You Swim, Practice Jump Rope and Strength Training , if You're a Cyclist, Your Ligaments May Be Weak in Lateral Movements, so Perform Lateral Lunges and Monster Walks with Resistance Bands to Compensate for This Imbalance
COMPRESSION AND DECOMPRESSION ALTERNATION
To Promote Cartilage Hydration,
E.g. For Lower Body : Cycling (Compression On The Downstroke And Decompression On The Upstroke).
For Upper Body : Clubbell Exercises/Cycling/Trampoline
AVOID SEDENTARITY
Maintain An Activity Keeping Pain <2-3 Out Of 10
BETTER DIET
ANTIOXIDANTS: Berries, Avocados, Olive Oil, Nuts Supplements: Selenium, Vitamin C, Magnesium, Minerals


RECAP. MUSCLES
MAINTAIN LONG AND FLEXIBLE MUSCLES
PREVENT MUSCLE TEARS
HOLISTIC AND FUNCTIONAL STRENGTHENING
PLIABIILITY
BAND WORKOUT
APPLY RHYTHMIC SLIDING PRESSURE On The Muscle While Contracting And Releasing It
MYOFASCIAL RELEASE Self-Massage Using A Foam Roller And Lacrosse Ball
WARM-UP PROPERLY Global (10 Minutes) + Local (2 Sets At Sub-maximal Intensity
HEAVY AND SLOW RESISTANCE WITH PAUSE In Bodybuilding (Softens Tendons) Pause In the middle Of The Repetition To Relax The Muscles. Move Slowly Feeling lLke Moving Through Molasses
4 SETS OF 15 REPS AT 70-85 % Of The "ONE REP MAX" Repeat 2 To 3 TImes /Week
DON'T NEGLECT ANY MUSCLE FOCUS ESPECIALLY ON THE "CORE" AND ROTATOR MUSCLES Obliques, Glutes, Tibialis Anterior, Hamstrings, Shoulder Rotators, Trapezius, Forearms, Foot Muscles, Psoas
PRIORITIZE MOVEMENT OVER HYPERTROPHY The Weak Link Principle E.g. What's The Use Of Being Strong At Bench Pressing If You Have A Weak Back?
FUNCTIONAL TRAINING involving Multiple Muscle Groups with Multiple Work Plans
BIG 7 MVT PATTERNS: Squats, Pushes, Pulls, Lifts, Lunges, Rotations, Movements
VERSATILITY + MOBILITY Being Good In A Wide Variety Of Activities, Not Excellent In Just One. Greater Range Of Motion
- STRENGTH TRANSFERABILITY -MULTI-JOINT MOVEMENTS -FREE WEIGHTS -STRENGTHENING MOVEMENT RATHER THAN MUSCLE -PERSONALIZED TRAINING (Morphology, Fitness Level, Past Injuries)


OPTIMIZATION OF MUSCLE GROWTH
BEGINNER
ADVANCED
(After 2 Years If Plateau)
FULL BODY WORKOUT
Tto Maximize Testosterone Production: Limit To 5 Compound Exercises
INTENSIFICATION TECHNIQUES Such As Superslow, Metronome-based Training, Blood Flow Restriction, PITT Force Training, Etc
GERMAN VOLUME TRAINING
The Best In My Opinion For Beginners
MAXIMUM TRAINING DURATION
45 Minutes
1G Of PROTEIN / LBS
Of Body Weight
PROTEIN SHAKE
1.5 H Before Weightlifting Session: Second Protein Intake Within the Hour Following the Session
DON'T FORGET CARBOHYDRATES
Muscle is Composed of 80% Water


UNBREAKABLE DIET
IF INJURED, DIET DEFICIENT, OR ENGAGED IN HIGH VOLUME PHYSICAL ACTIVITY
PROTEINS
1 g per Lbs
Ideal Protein Balance: 50% Animal-based / 50% Plant-based (Hemp, Pea, Soy, Etc.)
PEPTIDES (Pre-Digested Collagen):
15g of Peptides with Vitamin C One Hour Before Exercise. If Sedentary: One Hour Before Bedtime
Without Peptides : GELATINE
Bone Marrow and Other Gelatin-Rich Dishes (Head Cheese, Jellied Eggs, etc.) Jell-O As Dessert.
VITAMIN D
Link Between Musuloskeletal Issues And Lack Of Vitamine D
HYDRATATION
1/3 Gal Per Day
COLLAGEN
Marine or Grass-Fed Beef Collagen Certified. Every Evening, 1 Hour After Dinner or 1 Hour Before Physical Activity
LIMIT CAFFEINE INTAKE
At Three Cups a Day Excess Inhibits Collagen Synthesis
RECOMMENDED QUANTITY
Depends On The Size Of The Molecules. For Bovine Collagen, One Can Take 10g/day, But For Highly Assimilable Nano Marine Collagen, 1.5 To 3g Is Sufficient, Especially In A Course, If One Is A Heavy Athlete
BALANCED DIET
FOOD RICH IN GLYCINE/PROLINE/ LYSINE
Meat Stew
Turkey
Cod
Fish Broth
Poultry
Veal Liver
Cabbage
Tofu...
ROYAL JELLY
Stimulates Collagen Production. In A Course, Take 100 Mg To 250 Mg Per Day Of Lyophilized Royal Jelly For 30 Days
Multimineral Complex Against The Effects Of Sweating Linked To Sports
Hyaluronic Acid for Fascia Hydration and Thus Proper Fascia Glide
Epicatechin (Dark Chocolate)
Genistein Phytochemical Compound (Soy Extract)


HOW TO WARM UP PROPERLY BEFORE A WORKOUT?
GLOBAL WARM-UP
LOCAL WARM-UP
10 MINUTES OF LIGHT CARDIO
(Cycling, Brisk Walk, Etc.)
WARM UP FIRST THE DOWNSTREAM SEGMENT OF THE TARGETED JOINT
That Is Being Targeted. For Example, If You Have Elbow Pain, First Work/warm Up The Wrist
A SET OF SLOW WARM-UP EXERCISES WITH MAXIMUM RANGE OF MOTION
For Example, Slow Biceps Curls With A Resistance Band, Fully Extending And fully Flexing The Elbow
WORK THE FLEXORS BEFORE THE EXTENSORS
For Example, If You Have Elbow Pain, Perform Biceps Curls Before The Triceps. If You Have Knee Pain, Work The Hamstrings Before The Quadriceps


OPTIMAL COOLDOWN
10 MIN Of Cycling Or Rowing
LIGHT STRETCHING
Stretching Too Intensely While Warm May Cause Injuries
(Tendency To Go Too Far)
SELF-MASSAGE
(Foam Roller Lacrosse Ball)
CONTRAST SHOWER Vascular Benefits : Works On The Flexibility Of Blood Vessels (Dilatation And Contraction)
SMOOTH COOLDOWN
-Lowering Of Heart Rate
-Elimination Of Lactates
-Normalization Of Cortisol Levels
-Reparative Vascularization Of Myofibrils Broken Down By Exercise
-Normalization Of Blood Pressure

## Gelatin, peptides, hydrolyzed collagen which is the best option ?

To simplify, collagen is what you find in the skin, tendons, and cartilage of animals (there is no collagen in plants). While we sometimes consume skin, it is much less common to chew on cartilage, which remains generally hard after cooking, except in China where chicken feet are often eaten as a snack. Of course, we still absorb some when nibbling on a chicken carcass with our teeth, but generally collagen is easily consumable (and digestible) only when softened into gelatin. Gelatin is collagen denatured by slow, wet cooking at low temperatures (stews, bone marrow, broths, etc.). However, it is still possible to consume collagen without denaturation through prolonged steam cooking, pressure cooking, marinating, sous-vide cooking, or in a water bath.

Industrial gelatin is extracted using acidic solutions, which causes it to lose some of its properties, even though it becomes more digestible compared to "natural" collagen. Collagen hydrolysates, also known as peptides, are pieces of collagen that have not been denatured (unlike gelatin), but have been cut into small pieces for better intestinal absorption. Those of marine origin or certified to come from pasture-raised animals are the best option for obvious reasons of purity. The ultimate is nano liquid collagen, meaning cut into very small pieces and so highly absorbable. Liquid collagen would be the most assimilable of all. A consumption of 4 to 10 grams of collagen supplement per day is recommended.

It's important to understand that collagen supplementation is mostly recommended for vegans, those engaged in a lot of physical activity with little recovery (construction workers, ultra runners etc) or have an imbalanced diet. For an average athlete or someone who regularly consumes meat, collagen supplementation holds very little interest. Similarly, individuals hoping to alleviate joint pain by taking collagen supplements are often disappointed. Never someone told me that collagen supplements releaved his joint pain. It would be preferable for them to consume turmeric or omega-3 instead of turning to collagen, which has no notable effect on inflammation.

## Stretching The Tendon : Good Or Terrible Idea?

The Achilles tendon tends to become too flexible during degenerative phase. Stretching it is therefore unnecessary and even dangerous. On the other hand, the patellar tendon hardens when it is pathological, so it needs to be stretched in the form of dynamic stretching. As you can see, each tendon reacts differently, so when in doubt, avoid stretching a painful tendon.

## Ideas Of Tendon Rehabilitation Exercises

**Achilles Tendon**
-Standing tibial extensions with dumbbell + isometric tension at the top (15 sec)
- Isometric push against a wall (lying on the floor)

**Triceps**
- Overhead slam ball throws against a wall
- Rapid band triceps extensions

**Hamstrings**
- Nordic curls
- Eccentric with Swiss ball (two legs up and single-leg down)
- Romanian Deadlift (high Tendon Insertion)

**Quadriceps**
- Reverse nordic
- Spanish squat
- Backwards Sled pull
- Isometric loaded lunges
- Weighted slow lunges
- Sissy Squat on inclined board
- Lunges with elevated foot and knee over toes

**Adductors:**
- Copenhagen adductors with bent or straight leg

**Gluteus Medius**
- Single-leg side plank
- Hip Abductions with ankle weights : bent leg rising, straight leg lowering

**Gluteus Maximus**
- Elevated reverse lunge

**Shoulders**
- Dumbbell front raise, arms bent, slow descent (10s) with arms extended either in front or laterally

# Understanding The Tendons

Tendons have fewer blood vessels compared to muscles. Therefore, in case of injury (or even as a preventive measure), it's important to increase their vascularization using the technique I mentioned earlier : light, rapid, and long. In terms of performance goals, similar to muscles and ligaments, tendons can be strengthened through appropriate training (typically involving repetitions of 1 to 6 and heavy work or plyometric exercises). This strengthening leads to densification as well as hypertrophy. The goal is to balance rigidity with flexibility. Tendons also strengthen through volume ; for example, the patellar tendon diameter of fencers and badminton players has been measured to be 20 to 30% larger than that of the rear leg (Couppe et al., 2008). When walking, the quadriceps tendon is relaxed. It only tightens during running and more significant flexions, so walking is not a patellar tendon rehab exercise. During growth (adolescence) when adaptive capabilities are maximal, it's much easier to increase the size of tendons. Pathological enlargement due to inflammation and injuries also exists; thus, protruding tendons don't always indicate healthy tendons. Generally, tendons have twice the tensile strength of muscles, hence they require heavy loads for development. During isometric contraction, the tendon starts working when the muscle is fatigued; therefore, it's not immediate. It takes over after 45 seconds to 1 minute when the muscle begins to tremble to happen. This is notably visible in the wall sit exercise.

*The duramen (Center Part) of a tree is quite similar to the strongest tendon bundles built during adolescence*

An interesting fact revealed by carbon-14 dating is that the central material of the tendon does not renew itself during life, unlike muscle. The central part (the large fibers) is primarily formed during the growth period. It's like a tree: you have the heartwood in the center and new layers added each year.

It has been noticed that the tendon responds well to short training sessions of 10 minutes; afterward, it goes into a dormant phase and becomes active again after about six hours. Therefore, in theory, it can be trained multiple times a day but spaced six hours apart. For performance, the tendon should be tough but should not exceed the muscle's resistance capacity, otherwise, the muscle may tear during intense activity.

More and more people are engaging in high-intensity training, which is great for mitochondrial development and VO2 Max. However, this type of training (maximum effort for 30 seconds) is better done in swimming or cycling than running, where it can lead to muscle tears (I speak from experience).

## Understanding The Ligaments

Ligaments share many similarities with tendons, except they are not stretchable; their role is to maintain the joint tightly, without any play as they connect bones to bones. They strengthen when pulled multidirectionally. Of course these pulls should not exceed the resistance of the tissue. Football strengthens the cruciate ligaments more than jogging because of the changes of direction. The variety of angles used for a given exercise is essential. Hence, working out in 3D (Free weights, Kettlebells, Indian Clubs Vipr...) rather than with machines is essential for ligament strenght. Pistol squats, pivot jumps are particulary efficient for knees ligaments. Swinging soft loads (bulgarian bags, etc.) and moderate impacts (aquabags, throwing and catching medicine balls) strengthens ligaments of the wrist, elbow and shoulder because the pull vectors are multidimentional and random. Ligaments can thicken through training, but (like tendons) they also thicken if injured. They profit from exercises with full range of motion performed within the joint axis and they are strengthened through traction, for example, for the patellar ligament, when performing a lunge with the knee over the toes (full R.O.M. and traction). Voodoo flossing and K tape should be used in case of sharp pain and trigger points.

## Heavy Slow Resistance Training

*The protocol is simple :*
- 12 Weeks
- 3 To 5 SETS - 15 REPS 3"/3" (3 seconds concentric and 3 seconds eccentric).
- Ideal training for tendon health (for prevention or rehabilitation).
- Intensity 70-85% of 1RM (One Repetition Maximum). meaning a weight you can lift 15-12 times
- Three Times/Week
- Time Between Rest : 2-3 Min

### Exemple Of HSR Program

| | |
|---|---|
| Week 1 | 3 Series Of 15 RM |
| Week 2 et 3 | 3 Series Of 12 RM |
| Weeks 4-5 | 4 Series Of 10 RM |
| Weeks 6-8 | 4 Series Of 8 RM |
| Weeks 9-12 | 4 Series Of 6 RM |

*Between 20 to 40 Reps In Total*
*By Session (one or multiple Exercises)*

## Isometrics

Isometric exercises do not change the length of the tendon since there is, by definition, no movement (it involves contraction against an immovable object). Long isometric holds (at least 20 seconds) are beneficial because they tire out healthy tendon fibers, stimulating contraction in the injured area, thereby accelerating healing and tissue reorganization

- Minimum time: 20 seconds, maximum: 45 seconds (average duration is 30 seconds)
- 2 minutes of rest between sets
- 4 series
- Maximum duration : 10 minutes including rest.
- Tendons, as well as ligaments, strengthen through isometric exercises.
- This training can be done multiple times a day: e.g., 10 minutes in the morning, noon, and evening. Maintain a 6-hour gap between sessions.

## Light, Fast And Long

This consists of performing more than 100 consecutive repetitions with light resistance bands, while allowing the muscle to relax during the eccentric phase of the movement,. Ensure full range of motion, avoid congestion by relaxing the muscle as much as possible, and execute rapid movements. This technique is effective for vascularizing an injured tendon, enhancing its resilience, or expediting its healing process, making it suitable for both prevention and rehabilitation. Although this method slightly toughens the tendon, resembling a form of plyometric exercise, it remains non-aggressive when utilizing bands and resistance levels too low to cause injuries associated with the jerking effect, a common aspect of plyometrics.

*Recommended frequency: Twice daily*

Similarly, curved threadmill and fast downhill running (if you have good knees) belongs to this category, as it engages fast-twitch fibers and stiffens the tendon with minimal reaction force due to the sloped terrain.

## Plyometrics

Plyometrics is a strengthening method characterized by rapid stretching followed by quick contractions. It encompasses eccentric, isometric, and concentric movements, exemplified in exercises like depth jumps, where one jumps from a height, say 16 inches, and immediately rebounds. This form of training optimizes tendon performance in uninjured athletes by significantly toughening tendons. However, it also poses a high risk of injury due to the variable acceleration of movements, known as the "jerk". For example, while high-speed cycling carries a low risk of tearing, unprepared sprinting can strain tendons, leading to hamstring tears. The abrupt deceleration upon ground impact, followed by rapid re-contracting to regain speed, illustrates the concept of "jerk", a primary factor in non-contact tendon injuries. Athletes heavily engaged in explosive training within their sport should avoid additional plyometrics during the season to maintain tendon-muscle balance and prevent excessive tendon stiffening, which can precipitate muscle tears. Instead, they should focus on heavy, slow training. In rehabilitation, plyometric techniques can be utilized with the "light, fast, and long" approach. For instance, using resistance bands with less than 30% of 1RM and performing fast repetitions (50 to 100) of triceps extensions or biceps flexion while relaxing muscle tension during the eccentric phase.

## One Principle

Muscle strength >> Tendon strength = Tendonitis

Tendon strength >> Muscle strength = Tear

**AIM FOR BALANCE !**

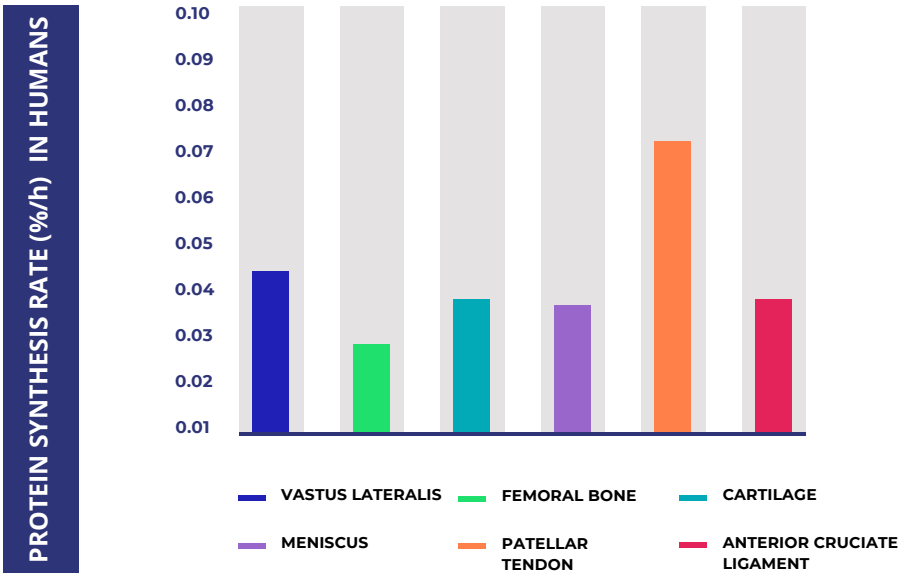
## Healthy Tendon

Hard towards the bone

Soft towards the muscle

## The Four Pillars Of Anti-Fragility


## Everything In The Body Regenerate




Source : Protein synthesis rates (%/h) of muscle, tendon, ligament, cartilage, and bone tissue in vivo in humans Joey S. J. Smeets and Al. 2019

For a long time, the prevailing belief was that only muscles and tendons could repair and grow. So, when I assert that cartilage also undergoes rebuilding, which is indeed great news, skepticism often arises. However, recent studies, as illustrated in the diagram above, reveal that the entire body is capable of regeneration. Within 7-10 years, almost all of the body's cells have been replaced. Without this capacity, the body would sustain significant damage following periods of activity, which fortunately is not the case

## important Facts To Know

- Isometric exercises strengthen muscles and maintain tendon flexibility, promoting overall tendon health.
- Prolonged isometric exercises over 20 seconds fatigue the healthy tendon portion, stimulating degenerative fiber activation and healing.
- Immobilizing a tendon for three days can cause a 20% collagen loss, emphasizing movement's importance for tendon health.
- Overtraining should be avoided as tendinopathies typically cause delayed pain post-exercise.
- Sports like swimming, cycling, and rowing have fewer tendon issues due to low impact.
- Three short daily training sessions, each 5 minutes long and spaced six hours apart, can target tendon health effectively. For example, three brief sessions of jump rope exercises benefit the Achilles tendon.
- High heels stiffen and weaken the Achilles tendon.
- When dealing with tendonitis, avoid compressive positions. For instance, individuals with biceps tendonitis should avoid deep shoulder flexion.
- Tendons are mainly collagen, comprising 80% of their composition.
- Athletes in fast or ballistic sports need stiffer tendons for rapid movements.
- Rest and targeted rehabilitation are crucial for tendon injury healing, with well-managed tendonitis resolving within two months.
- Even slight workload increases can trigger tendon issues in case of degenerative tendinopathy, so better be extra carefull
- The Achilles tendon bears six times body weight with each running stride, increasing injury susceptibility.
- The 400-meter dash is the most tendon based race.
- Pathological tendons retain water, causing discomfort. Isometric exercises help remove excess water.
- Women have looser ligaments but are less prone to muscle tears due to less rigid tendons, though this changes after menopause.
- Men are more susceptible to Achilles tendon ruptures.
- Tendonitis affects 2 to 5% of the population, with increased risk after 40 due to tendon stiffening.
- Patellar tendonitis hardens the tendon, while Achilles tendonitis softens it, reflecting different tendon pathologies.

## Example Of Program For Patellar Tendonitis

It can be easy to get lost in the complexity of protocols. Which ones to choose? How to dose them. Here's what I advise you to do if you have, let's say, a patellar tendonitis. The simplest technique to start with is isometric exercises, ideally performed with the joint positioned at a mid-range angle. For instance, if you're dealing with patellar tendonitis, you can initiate your routine with 3-5 sets of isometric exercises using a leg extension machine, focusing on one leg at a time. Maintain the knee at a 60° - 70° angle, and engage in ramp contractions (gradually increasing in intensity) for 30 seconds.

Aim to perform these exercises five times a week, ensuring that the machine is loaded to its maximum capacity to prevent the ankle pad from moving. In addition, it's crucial to incorporate exercises that unload the tendon, such as those targeting the hamstrings and glutes, for a duration of at least a month. These exercises help to alleviate stress on the affected tendon, allowing it to recover effectively. By focusing on strengthening the hamstrings and glutes, individuals can improve overall lower body stability and support, which further contributes to tendon health and rehabilitation. After one month, you can progress to heavy and slow training, characterized by 8 to 12 repetitions at 70-85% of your one-rep maximum (1RM). This entails employing a 5-5 tempo, which involves 5 seconds of contraction followed by 5 seconds of relaxation. Once your pain has significantly decreased, you can progress to a phase of plyometric training, particularly if it aligns with the demands of your sport. For instance, incorporating exercises like Pogo Hops (hopping in place with minimal knee flexion, focusing on ankle movement) or alternating jumping lunges can be beneficial. These plyometric exercises help to enhance explosive power, agility, and proprioception while minimizing stress on the tendons.  You'll also need to change your movement patterns to reduce knee dominance in your movements and jumps and focus more on engaging your glutes and hamstrings.

# How to Use The Sheets?

To decide what needs to be done, you need to ask yourself the right questions. Are you injured? Are you in an acute, subacute or chronic phase? Do you want to prevent injuries? Improve your performance? What is your age? What is your type of sport?

For instance:
- During the acute phase of injury, it's crucial to rest for 3 to 4 days. If dealing with reactive tendinopathy, this rest period might suffice to resume activity without pain. However, in cases of degenerative tendinopathy, after three days, pain may persist or even worsen. Prioritizing isometric exercises becomes essential for pain management.
- Transitioning into the subacute phase, where pain might resurface but with reduced intensity, the focus shifts to eccentric training and heavy slow exercises. Yet, the fundamental approach remains consistent: engage in rehabilitation exercises for 10 minutes, 2 to 3 times a day, with intervals of at least 6 hours between sessions.
- For preventing tendonitis or managing chronic phases (where pain is absent but can recur with exertion), the light fast and long technique is advisable. Examples include elastic pronation flexions for tennis elbow or pogo hops for Achilles tendon.

If my pain is deep within the joint and persistent, I can incorporate the Voodoo band technique, especially if it's related to ligamentous pain, as it effectively targets ligaments as well. Plyometric training is a performance technique that should ideally be preceded by a prolonged period of isometric training, as they are complementary in nature. Isometrics enhance muscle stiffness, while plyometrics enhance tendon stiffness. As previously mentioned, maintaining a balance between muscle and tendon stiffness is crucial. Insufficient muscle stiffness increases the risk of tears, while inadequate tendon stiffness results in reduced speed, lower jump height, and mediocre acceleration. Thus, it's vital to harmonize both aspects, with pain serving as a guide to gauge progress. For individuals recuperating from injuries, I strongly advise an extremely gradual approach to plyometric training, as even a slight increase in workload could trigger a recurrence. The question arises: is plyometrics truly necessary for you? Are you involved in a ballistic sport centered on activities like throwing, jumping, kicking, and speed? While everyone can benefit from a moderate dose of plyometrics, excessively stiffening the tendons poses risks. Athletes can be categorized as either tendon-dominant or muscle-dominant. The tendon-dominant athlete tends to be stiff and robust but may lack significant muscle mass, akin to a cat. On the other hand, the muscle-dominant athlete excels in force absorption, accelerations, and decelerations.

# Taping

## Voodoo Flossing

This method, which involves wrapping the joint (or the injured tendon area) with an elastic band, tightening to limit blood flow followed by mobilizations, has not been scientifically proven. However, it could induce a reorganization of collagen fibers. Essentially, healthy collagen fibers are like well-aligned spaghetti, while diseased ones are disorganized. The goal of the exercise in rehabilitation is to create tension or stretch that signals them to realign.

*Technique*
*Overlap about half the width of the band, stretched around 50-75 percent. Once the area is wrapped, mobilizations or exercises with weights should be performed for about 1 to 2 minutes. It's important not to exceed this duration because the restriction of circulation should not last long.*

## Kinesio Tape (K Tape)

You've likely noticed athletes adorned with vibrant, crisscrossed bands stucked to their backs or limbs. These are known as kinesio tape (KT), designed to enhance local circulation, alleviate pressure on inflamed and painful tendons (decompression), and bolster joint stability during the healing process. These tapes are readily available for purchase, and instructional tutorials can be found on YouTube for easy application. While application is straightforward, an extra hand may be necessary for reaching your back, shoulders and arms. Kinesio tape is particularly effective for conditions such as Achilles tendon issues, peroneal tendonitis, tennis elbow, and more.

# Examples Of Sports Good For Your Joints

Aqua gym

Contrary to popular belief, aqua gym is not necessarily the comfortable gym we know. In fact, centers for top athletes use it for both pre-rehabilitation and rehabilitation. Former UFC champion Bas Rutten, surfer Laird Hamilton and Georges Saint-Pierre all practice high intensity aqua gym to strengthen their bodies after extreme sports (12). The liquid element means you can put 100% of your strength into the exercises, even if you've suffered an injury (cortical disinhibition principle). It stimulates tendons and ligaments. If you want to try it out, simply invest in a pair of Aquagym gloves to increase the surface area of your hand, and you'll be able to perform the same type of movements as you do at the gym: shoulder flexions, arm adductions for pectoral muscles, lateral splits, etc. There are also foam Aquagym dumbbells for working arms and shoulders.

Climbing

Climbing not only exercises the whole body, but also the mind: problem-solving, tenacity and creativity. The movements possible in this sport are almost infinite.

Rowing

Rowing puts little stress on the joints and gently strengthens the body. It's one of the most complete sports and will build muscles and a heart of steel. Rowing on a river or l is like night and day,but not everyone can do it outdoors.

The trampoline

The trampoline is an essential accessory for rehabilitation of the lower limbs. It also stimulates lymphatic circulation and cardio, and works the calves, buttocks and even the arms if you tilt it to bounce a medicine ball.

Mountain biking

Mountain biking stimulates more muscles than conventional cycling if you do it in the forest and on hilly terrain. It's a complete sport that will develop your arms, shoulders, back (and legs, of course), without risk.

Running

Even with 'bad knees', it's still possible to jog with minimal impact by rolling off the foot (it's more ankle work than knee work, and very similar to brisk walking). For those who don't have knee problems, have your stride checked in a sports shoe shop (analysis on a treadmill). This will enable you to detect any parasitic movements that make your running tiring and stressful for your joints

Capoeira

A superb Brazilian sport that combines strength and mobility. The rotation of the spine is particularly interesting from a functional point of view.

# Last Words

If you have a question related to the book (a passage you don't understand or a question about the training), you can contact me at ajeanluc@gmail.com, and I will respond. The response time will depend on my availability.

*I would be very grateful if you could take few minutes to leave an honest review on Amazon. This increases its visibility and makes it accessible to more people! It also helps to improve it for later editions. Thank you in advance! :)*

As I did have only one proofreader, it is possible that some typos remain. If this is the case, please accept my apologies in advance and let me know at ajeanluc@gmail.com.

If you want to follow me on social media my youtube channel is called “KineForce” and on instagram kine.force.

# GLOSSARY

**Bioplasticity**: Reorganization of biological tissues (regeneration following injury, for example).

**Joint Capsule**: The ligament sheath that surrounds and supports the joint.

**Joint Centering**: Bringing the bone back to the center of the joint to strengthen it. Example: bringing the head of the humerus (shoulder) back to the center of the glenoid cavity.

**Concentric**: The forward phase of a movement with shortening of the muscle (pushing the bar in bench press).

**Cyclic Sport:** Sport consisting of a single movement repeated thousands of times (e.g. running).

**Distracting**: Creating space in the joint capsule, opening up the joint by pulling on the bones, decompressing.

**Eccentric**: The return phase of a movement in which the muscle works in elongation. For example, bringing the weight down in a biceps curl.

**Fascias**: Fascias are fibrous bands that 'wrap' muscles, bones, and viscera. They run throughout the body, giving it elasticity and strength. There are a dozen or so lines (anterior, spiral, etc.).

**Isometric**: Contraction of the muscle without joint movement (example: doing a wall chair exercise for the quadriceps).

**Myofascial Massage**: Massage with a foam roller or Lacrosse ball to soften muscles and fascia.

**Mobility**: Active range of movement that can be used by muscle power alone.

**Neuroplasticity**: The ability of neurons to reorganize and communicate differently (e.g. lowering the pain threshold through exercise).

**Pandiculation**: Dynamic stretching (without remaining in the stretching position)

**Pliability**: Mobility without prior warm-up, involving long, strong muscles.

**Prehabilitation:** Type of training aimed at protecting against injury and "concreting" the joint.

**Synovial:** A viscous liquid resembling raw egg white in which the joint is immersed

# BIBLIOGRAPHY

## STUDIES AND VIDEOS


1 Effects of plyometric and isometric training on muscle and tendon stiffness in vivo Keitaro Kubo, Tomonobu Ishigaki, and Toshihiro Ikebukuro Physiol Rep. 2017 Aug; 5(15)

2 Running exercise strengthens the intervertebral disc, Daniel L. Belavý, Matthew J. Quittner, Nicola Ridgers, Yuan Ling, David Connell & Timo Rantalainen Scientific Reports volume 7, Article number: 45975 (2017)

3 Weekly Bone Loading Exercise Effects on a Healthy Subjects Strength, Bone Density, and Bone Biomarkers, Ann Tsung, Daniel Jupiter, John Jaquish, Jean Sibonga, Aerosp Med Hum Perform 2021 Mar 1;92(3):201-206

4 Analysis of "old" proteins unmasks dynamic gradient of cartilage turnover in human limbs Ming-Feng Hsueh, Patrik Önnerfjord, Michael P. Bolognesi, Mark E. Easley, Virginia B. Kraus. Science Advances 09 Oct 2019:Vol. 5, no. 10

5 Hypertrophied cruciate ligament in high performance weightlifters observed in magnetic resonance imaging, Piotr Grzelak, Michał Podgorski, Ludomir Stefanczyk, Marek Krochmalski, and Marcin Domzalski, Int Orthop. 2012 Aug; 36(8): 1715–1719

6 Bone Mineral Density in Competitive Athletes, Antonio, J., Leaf, A., Carson, C., Ellerbroek, A., Silver, T., Peacock, C., Bommarito, P., Knafo, S., Tartar, J. Journal of Exercise and Nutrition, (2018). 1(2), 1-11

7 Ebonie Rio, Dawson Kidgell, Craig Purdam, Jamie Gaida, G Lorimer Moseley, Alan J Pearce, Jill Cook. Isometric exercise induces analgesia and reduces inhibition in patellar tendinopathy. Br J Sports Med 2015;49:1277–1283

8 Malliaras P, Barton CJ, Reeves ND, Langberg H. Achilles and patellar tendinopathy loading programs : a systematic review comparing clinical outcomes and identifying potential mechanisms for effectiveness. Sports Med. 2013 Apr;43(4):267-86

9 Keith Baar - Physical training, performance and injury prevention
https://www.youtube.com/watch?v=CgcR5J1dwcY&t=2452s&ab_channel=Sportskongres

10 Jill Cook - Current concepts in tendinopathy rehabilitation
https://www.youtube.com/watch?v=-kKzoi8Zrik&t=852s&ab_channel=sportfisioswiss

11 Muscle Tendon Growth Strengthen And Training Effect with Dr. Vizniak
https://www.youtube.com/watch?v=EEXmGTRRwm0&ab_channel=prohealthsys

12 TRAIN LIKE A BEAST! EXCLUSIVE Bas Rutten Personal POOL Workout!
https://www.youtube.com/watch?v=qgvklHZSsmE&ab_channel=BasRutten

13 Abate M, Silbernagel KG, Siljeholm C, Di Iorio A, De Amicis D, Salini V, Werner S, Paganelli R. Pathogenesis of tendinopathies: inflammation or degeneration? Arthritis Res Ther. 2009;11(3):235.

14 Q & A with Louie Simmons: Bands & Hypertrophying Connective Tissue
https://www.youtube.com/watch?v=SqsolpxSs2g&t=123s&ab_channel=JohnQuint

15 https://vijayonline.in/2020/07/25/fluctuating-stresses/

16 Associations of grip strength with cardiovascular, respiratory, and cancer outcomes and all cause mortality: prospective cohort study of half a million UK Biobank participants, Carlos A Celis-Morales and Al. BMJ 2018;361:k1651

17 ACTN3 genotype is associated with human elite athletic performance. Yang, N., MacArthur, D. G., Gulbin, J. P., Hahn, A. G., Beggs, A. H., Easteal, S., et al. (2003) Am. J. Hum. Genet. 73, 627–631

18 J L Cook, E Rio, C R Purdam, S I Docking. Revisiting the continuum model of tendon pathology: what is its merit in clinical practice and research? Br J Sports Med. 2016 Oct; 50(19): 1187–1191

19 Montagna, C., Svensson, R.B., Bayer, M.L. et al. Autophagy guards tendon homeostasis. Cell Death Dis 13, 402 (2022)

20 Ceravolo MG. Action Observation as a Tool for Upper Limb Recovery. Fizikalna i rehabilitacijska medicina. 2016 Apr 3;28(1-2):144-50.

21 Gabel, L., Liphardt, AM., Hulme, P.A. et al. Incomplete recovery of bone strength and trabecular microarchitecture at the distal tibia 1 year after return from long duration spaceflight. Sci Rep 12, 9446 (2022). https://doi.org/10.1038/s41598-022-13461-1

22 Villafañe JH, Pirali C, Isgrò M, Vanti C, Buraschi R, Negrini S. Effects of Action Observation Therapy in Patients Recovering From Total Hip Arthroplasty Arthroplasty: A Prospective Clinical Trial. Journal of chiropractic medicine. 2016 Dec 1;15(4):229-34.

23 DePhillipo NN, Aman ZS, Kennedy MI, Begley JP, Moatshe G, LaPrade RF. Efficacy of Vitamin C Supplementation on Collagen Synthesis and Oxidative Stress After Musculoskeletal Injuries: A Systematic Review. Orthop J Sports Med. 2018 Oct 25;6(10)

24 Elhakeem A, Heron J, Tobias JH, Lawlor DA. Physical Activity Throughout Adolescence and Peak Hip Strength in Young Adults. JAMA Netw Open. 2020;3(8):e2013463.

25 “Unbreakable” bones prompt a hunt for genes  Yale Medicine Magazine, 2002 - Autumn

26 Chang A, Miller TT. Imaging of tendons. Sports Health. 2009 Jul;1(4):293-300.

27 Brinjikji W, Luetmer PH, Comstock B. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol. 2015 Apr;36(4):811-6.

28 Magnusson SP, Langberg H, Kjaer M. The pathogenesis of tendinopathy: Balancing the response to loading. Nature Reviews Rheumatology 2010 March:6(5):262-8.

29 https://www.gq.com/story/lebron-james-mike-mancias-interview

30 "One More Rep" Mentality is Bad for Longevity w/Pavel Tsatsouline | Joe Rogan
https://www.youtube.com/watch?v=EhQtknEfXLI&ab_channel=JREClips

31 Lewis T, Cook J. Fluoroquinolones and tendinopathy: a guide for athletes and sports clinicians and a systematic review of the literature. J Athl Train. 2014 May-Jun;49(3):422-7

## BOOKS

*L1 Overcoming Tendonitis: A Systematic Approach to the Evidence-Based Treatment of Tendinopathy, Steven Low, Battle Ground Creative; 1er édition (21 janvier 2020)*

*L2 The TB12 Method How to Do What You Love, Better and for Longer By Tom Brady*.Simon & Schuster (July 28, 2020)

L3 *Sandow's System of Physical Training*. Eugen Sandow. J. Selwin Tait & Sons; 1st edition (January 1, 1894)

You all know you need to exercise to keep your heart and muscles healthy, but would you like to know the secret to strengthening your bones and cartilage naturally and developing joints made of concrete, capable of supporting you for the rest of your life? Which exercises to select? Which training program should you prioritize? What type of muscular contraction to choose?

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