

TLR3 ultimately brings about a cell protective effect. It is also responsible for angiogenesis (new blood vessels). This is a result of the Mechanotransduction, previously discussed, whereby the pulse wave (mechanical input) creates a biological response to create new vessels (biochemical effect). The entire mechanism of how this occurs is still not entirely understood, but it is known to occur. TLR3 also triggers what we'd consider to be a more proper immune response and aids in delivering stem cells to help regenerate. Although TLR3 is known to trigger an early inflammatory response, it has a potent anti-inflammatory effect following. We should keep this in mind when we are administering pulse waves as too many and too much intensity might actually not work in the patient's favor. We know that TLR3 and TLR4 communicate. Ideally, the communication between the two helps to bring out the best innate treatment effects. However, this is not always the case.

So, where does ESWT come into play with all of this? What if I were to tell you that ESWT has been shown to not only help bone and tendons heal, but also increase blood flow in muscles? Can ESWT help prevent arthritis? Can it help with damaged cartilage, bone disease, motor function, can it regenerate muscles, and more? How about aiding organ tissue? Well, there are studies that show it does just about all of this. It does so through the aforementioned Mechanotransduction. The biochemical response that the body has to the unique ESWT.

Let's now apply that mechanical stimulation creating the biochemical effects we read about earlier (Mechanotransduction). We learned above that those injured cells leak certain constituents, leading to the TLR response. Physically, pulse waves (moving at over 3300 mph) essentially compress, then stretch the cell; and although they do NOT create damage of any kind or create heat, they trick the cell into thinking something is wrong.

This pulse wave effect stimulates the cells to release those same constituents that damaged cells leak, and as you can probably guess, the TLR respond. It is important to note that TLR3 is not tricked by just any compound coming out of a cell: TLR3 is only triggered by RNA. This is where pulse wave therapy gets even more interesting. Not only do the pulse waves imitate an injury scenario without actually creating any injury, but the pulse waves are effective at downregulating (reducing) the effects of TLR4 (the TLR that tends to create too much inflammation), while enhancing the effects of TLR3 (initial inflammation followed by an anti-inflammatory effect). These studies have shown that ESWT can help bodies heal and regenerate.

Safety Issues

Regarding safety, I quote the Dedes et. al. study Effectiveness and Safety of Pulse Wave Therapy in Tendinopathies, in *Mater Sociomed*, 2018 *"From the results of the present study, extracorporeal pulse wave therapy is an effective modality in relieving pain intensity and increase the functionality and quality of life in various tendinopathies such as plantar fasciitis, elbow tendinopathy, Achilles tendinopathy and rotator cuff tendinopathy. It can be done on an out-patient basis with no patient restrictions and there are no significant side effects. Extracorporeal pulse wave therapy as utilized in the current study seems to be a safe and effective treatment in all tendinopathies examined. Thus, patients who failed to respond to conventional treatment for any of the above tendinopathies can use pulse wave therapy as an alternative method, which can significantly improve pain, functionality and quality of life."* The studies show that ESWT is used with more than just tendinopathies, and the data are clear that it is very safe and offers excellent results.