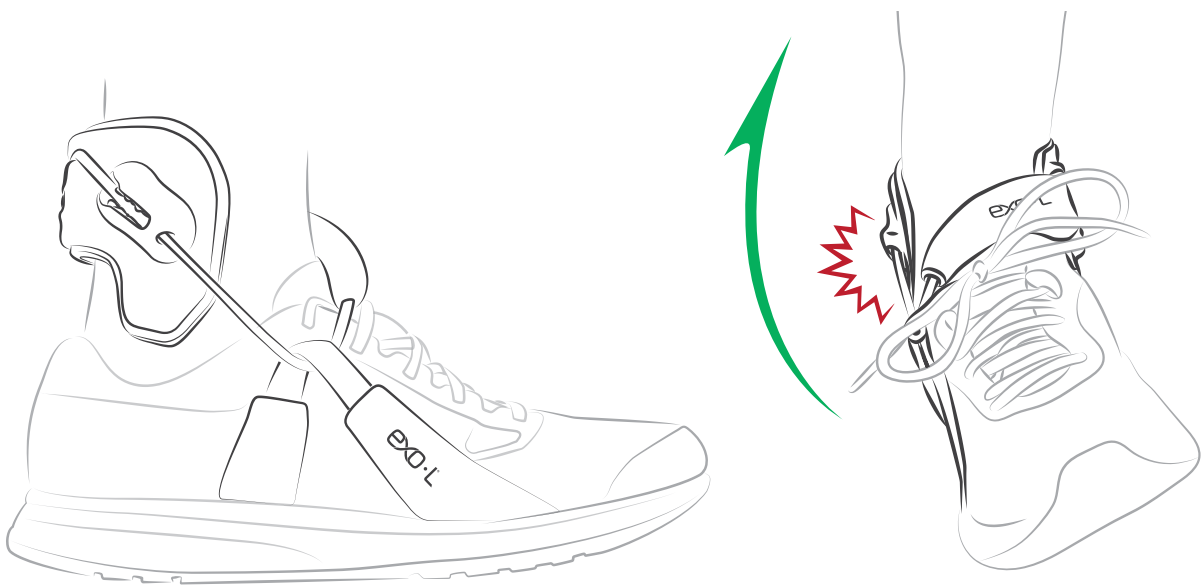




# THE EXTERNAL ANKLE LIGAMENT MEDICAL BACKGROUND



## INTRODUCTION

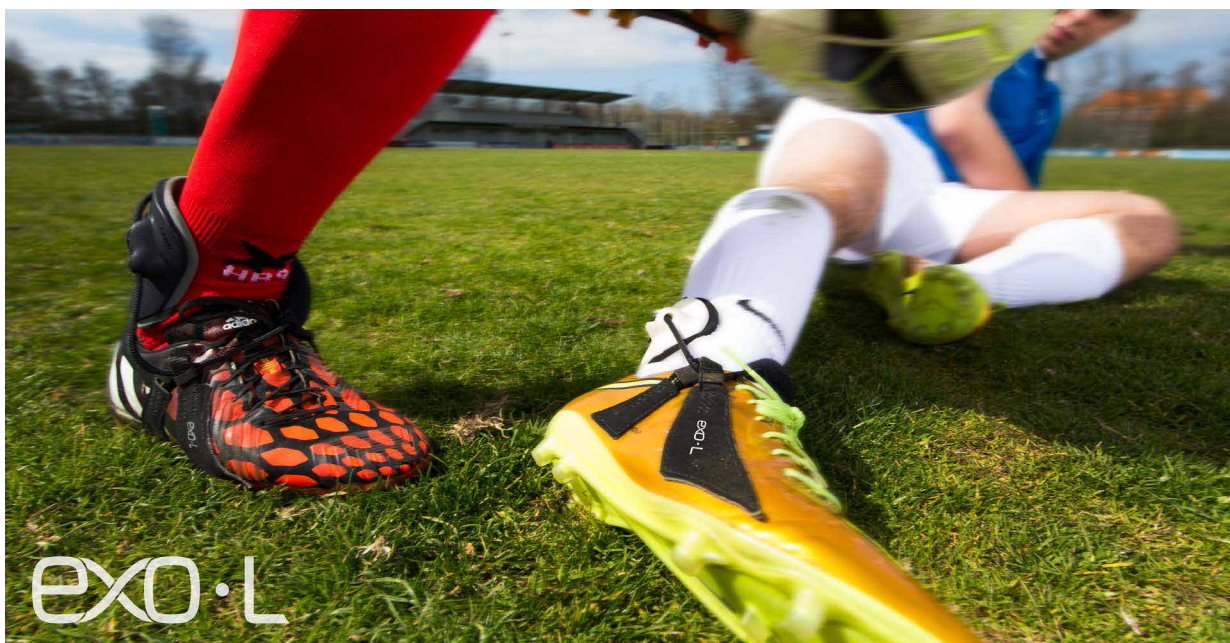
Every year millions of people experience a traumatic ankle sprain: a common problem which is mostly sports-related. Not only are these injuries painful, they also limit people's freedom to exercise, work, move around as usual, and perform to their full potential (*Dutch Consumer Safety Institute, 2014*)

Ankle sprains and limited mobility are bad news for any active person. The good news is that there is now a solution for these problems: an external ankle ligament that, in contrast to conventional braces and tape, provides reliable natural support for the ankle as well as an optimal sense of freedom.

This patented method of ankle sprain protection is based on extensive testing. It has been developed in partnership with renowned research institutions, including the Delft University of Technology and the Erasmus Medical Center.

The EXO-L Ankle Ligament (Fig. 1) supports the body's natural ligaments by providing a safety belt that is attached to the outside of the shoe, via a special fastening feature. The product is custom made using advanced 3D-scanning and 3D-printing technology. In this way a perfect fit to the user's body, as well as a highly effective extension of (sports) equipment, is created.

This brochure describes what ankle inversion trauma entails and explains in more detail how the EXO-L Ankle Ligament works to prevent it from happening.



**Fig. 1.** EXO-L in use

## INVERSION TRAUMA

Ankle sprains, especially inversion traumas, are the most common form of ankle injury. Contact sports, indoor sports and sports involving large amounts of jumping are particularly known for causing a high frequency of acute ankle injuries. Every year millions of people sprain their ankles worldwide and approximately half of those injuries require treatment by a doctor (*Dutch Consumer Safety Institute, 2014*).

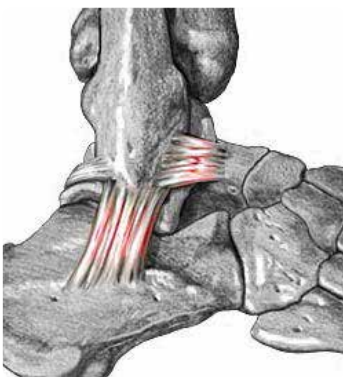
A wealth of research has been conducted into ankle sprains, providing functional anatomic descriptions of what causes this trauma. In nearly all cases, the anterior talofibular ligament ('ATFL') is affected, sometimes accompanied by injuries to the other lateral ligaments (*NHG.org, 2013*). Distortion of the ATFL is due to exorotation of the lower leg. During this movement, the tibia and fibula rotate in relation to the talus and calcaneus, putting stress on the ligament (*Riezebos & Lagerberg, 1998*).

Most cases of inversion trauma happen because of an unfortunate landing, a quick chopping move or a stumble. For this reason, inversion trauma is sometimes called an 'ankle roll' – a component of plantarflexion is present. A plantar-flexed foot can twist further out of the tibia-fibula fork because of the way the talus is shaped (trapezium), causing the ATFL to stretch even more (*Barnet & Napier, 1950; Fong et al., 2010*).

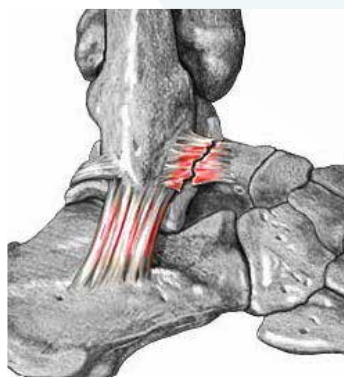
An inversion trauma of the ankle can lead to:

- a distortion/stretching (Grade I; Fig. 2)
- a single rupture (Grade II; Fig. 3)
- multiple ruptures of the lateral ligaments (Grade III; Fig. 4).

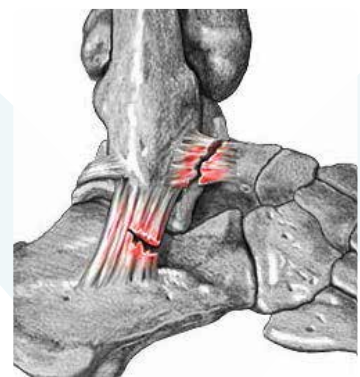
All sprains lead to limited mobility, and 60-90% of athletes require at least 12 weeks to regain the same level of activity they had prior to the injury. Large numbers of patients with acute ankle injuries continue to display residual symptoms for an even longer period. Furthermore, patients with a functionally treated rupture take 2.5 weeks off work on average, and 10% is still unable to resume work six weeks after the injury (*Royal Dutch Society for Physical Therapy, 2006*).



**Fig. 2. Grade I**



**Fig. 3. Grade II**



**Fig. 4. Grade III**

# BRACING & TAPE

Conventional braces and tape have been used for many years to reduce the risk of injuries. However, both forms of protection pose a number of limitations (Dutch Consumer Safety Institute, 2014). These were taken into account during development of the EXO-L Ankle Ligament.

## Conventional braces

The way various types of braces work and how effective they are has been researched extensively, but no particular type of brace has emerged from this research as a clear best choice. What is clear, however, is that external protection helps to reduce the risk of injury (Janssen et al, 2014).

There are considerable differences among the hundreds of types of conventional braces, not only in terms of their purpose but also in terms of their fit and comfort. As research has shown, the more rigid the brace, the less comfortable it is and the greater mechanical restriction it causes (Barnet & Napier, 1952; Gross & Liu, 2003; Dizon & Reyes, 2010).

Conventional braces have the following drawbacks:

- Conventional braces often limit freedom of movement.
- The enormous number of products on offer means that buying the right conventional brace requires expert advice.
- Despite the great diversity in shapes and sizes, a conventional brace remains a universal product which rarely fits perfectly around the ankle and foot.
- Conventional braces must be worn inside the shoe, causing both brace and shoe to wear out quickly and irritate the user's skin.

## Tape

Tape is also used to prevent ankle sprains, both by athletes who have not been previously injured and by those with chronic ankle injuries.

The purpose of tape is twofold. Firstly, it stabilizes joints by limiting movement in a specific direction. Secondly, it affects the muscular activity surrounding the joint by means of proprioceptive reflexes. However, research also shows that these effects are only temporary because tape stretches quickly (Wees et al, 2006).

Tape has the following drawbacks:

- The adhesive substances used can cause allergies or skin irritation.
- Frequent taping is expensive.
- Tape can only be applied correctly by a professional or under expert guidance, and the process is time consuming.
- A large share of the stability provided by tape (20% to 40%) is lost in a relatively short time.
- Tape is generally not supposed to get wet.
- Ankles typically need to be shaved for tape to be applied.

# EXO-L

The EXO-L Ankle Ligament was developed with the intention of providing greater assurance during physical activities by supporting the ankles as much as possible when they are at risk of being sprained. Moreover, the developers strived to provide a sense of freedom that boosts mobility and performance (Fig. 5).

The EXO-L is not a conventional brace or tape designed to fix the joint in place. Instead, it works as a safety belt for the ankle.

The EXO-L Ankle Ligament cleverly mimics human anatomy. The most common type of inversion ankle injury – the stretched anterior talofibular ligament ('ATFL') – is prevented by adding an external ligament, in the form of a strong cord, to the outside of the ankle. Similar to a seat belt in a car, the cord only tightens when a specific, risky motion is detected. This supports the function of the natural ligament and slows problematic movement when you are at risk of spraining your ankle (Fleuren, 2011).

The external ankle ligament is fully customized to perfectly fit every user through a 3D-scan of the ankle and 3D-printing technology.

During use, the protective cord of the EXO-L is connected to a special fastening feature which is attached to the side of the shoe (Fig. 6).

**The EXO-L Ankle Ligament offers the following benefits:**

- EXO-L prevents the movement that causes ankle sprains while allowing full freedom of movement in other directions.
- EXO-L always fits perfectly, as an unobtrusive extension of the user's own body and existing (sports) equipment.
- EXO-L can be extensively used as a preventive measure to avoid sprains, without affecting the natural ankle stability.
- EXO-L does not take up any space in the wearer's shoe.
- EXO-L is easy to put on and adjust.

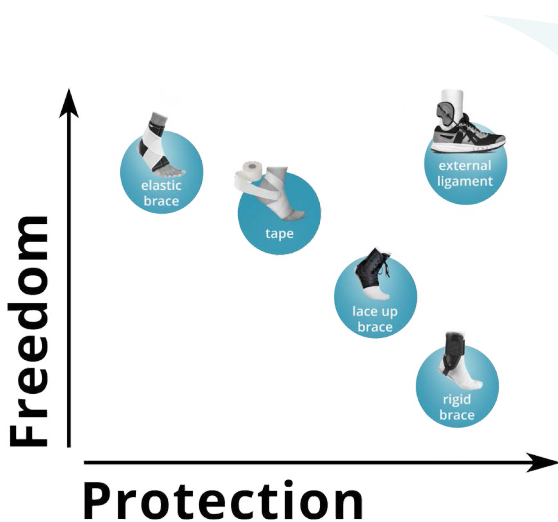


Fig. 5. Freedom vs. protection



Fig. 6. Positioning and attachment to the shoe

## Using the EXO-L

The procedure for using the external ankle ligament is easy and starts by simply putting on your shoes. The EXO-L Ankle Ligament is positioned on top of the malleoli, as shown in Figure 7. Next, the cord goes from the inside, across the top of the foot, and through the attachment feature on the shoe, before finally connecting to a clamp on the outside of the EXO-L. You will be ready for action in no time, and you can easily adjust the tension of the cord whenever necessary.

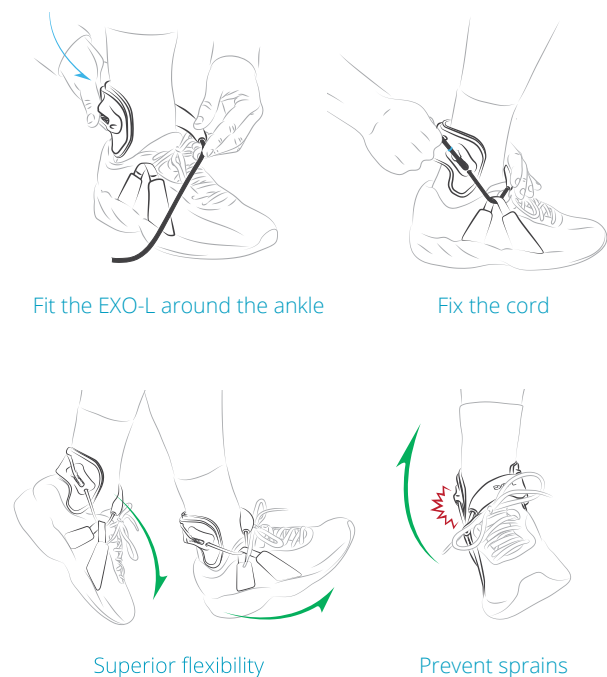
You will enjoy your normal freedom of movement and you will only notice the EXO-L if you find yourself at risk of spraining your ankle. Then the cord of the EXO-L will tighten to effectively slow down the spraining movement and protect you from injury.

## Custom made

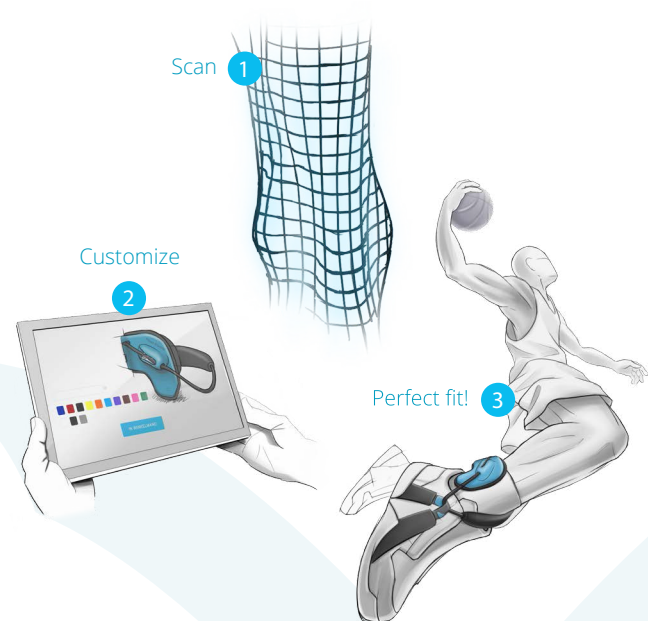
An innovative 3D-printing technique is used to adapt the EXO-L Ankle Ligament to each ankle, based on measurements that are taken with a 3D-scanner. This technology forms the basis for a perfect fit (Fig. 8).

Moreover, users can customize the appearance of their EXO-L Ankle Ligament. Everyone is free to select their preferred color and add text that is then engraved into their EXO-L.

Every low-top shoe can be modified for use with EXO-L. This takes just one day. For even more convenience, new shoes can also be purchased directly from EXO-L.



**Fig. 7.** Fitting procedure, flexibility and protection



**Fig. 8.** EXO-L customization

**We hope that this brochure has sparked your interest in the EXO-L Ankle Ligament!**


Please visit [www.exo-l.com](http://www.exo-l.com) for more information about this innovative product, including user testimonials, the results of clinical research and purchasing information.

If you are a medical professional, or active within the sports industry, you probably encounter lots of people with ankle sprains. You are more than welcome to contact us with any questions you may have about EXO-L. We will also be happy to discuss the possibilities of longer-term cooperation.



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