EXOLIGAMENTZ - THE FINGER-PROTECTIVE SPORTS GLOVE

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ABSTRACT

Exoligamentz is a **finger-protective sports glove** which includes distinctive joint protection techniques resulting in a new concept of a functional orthosis. Sports with usage of a kimono, like Brazilian jiu-jitsu and judo have a notable higher frequency of finger and wrist injuries. Taping is commonly done to protect the fingers, however, it has its limitations. Therefore, the unique design of this glove strives to restrict abnormal motion of the fingers, while maintaining functional, physiological movement of the athlete's hand during sports activity.

Key Words: SPORTS, GLOVE, INJURY PREVENTION, FINGERS

1. INTRODUCTION

In combat sport where a kimono is worn, fingers are indicated as the most common injury location due to grip fighting, for judo figures show up to 30% **[1,2]**. In many cases the athlete does not respect the time that is needed to fully recover the injury and proceeds with her/his training with an injured finger. This is one of the decisive reasons, alongside a lower quality of the healed scar tissue in ligaments, why an acute injury develops into a chronic injury. It is in this phase that a more serious problem starts, development of osteoarthritis (OA), which is one of the most devastating chronic conditions that affect people around the world. Already in 1997 P. Strasser et al. stated: "extensive Judo seems to be a risk factor for the development of osteoarthritis of the finger joints due to chronic-repetitive micro- and substantial (macro-) injury" **[3]**. The disease is usually linked to elderly but athletes and younger individuals are also susceptible due to consistent trauma during athletic performance. Taping is a way to prevent the fingers from injuries, however, it is very time consuming and is therefore often omitted.
The aim of this research is to create a glove with a patented design that prevents the initial repetitive finger injuries that form a significant predisposing factor to the development of OA because it gives the correct protection and is easy in use.

2. FUNCTIONALITIES OF THE GLOVE

The main purpose of the glove is to protect the fingers from being injured during sport activities such as Brazilian jiu-jitsu or judo. This means that the glove should be an external support for the joints by following the anatomy and biomechanics of the human fingers and by restricting abnormal movement but allowing functional movement.

Figure 1 gives a schematic of the glove, labelling its functional components such as the very important cruciate ligaments and the ring straps.

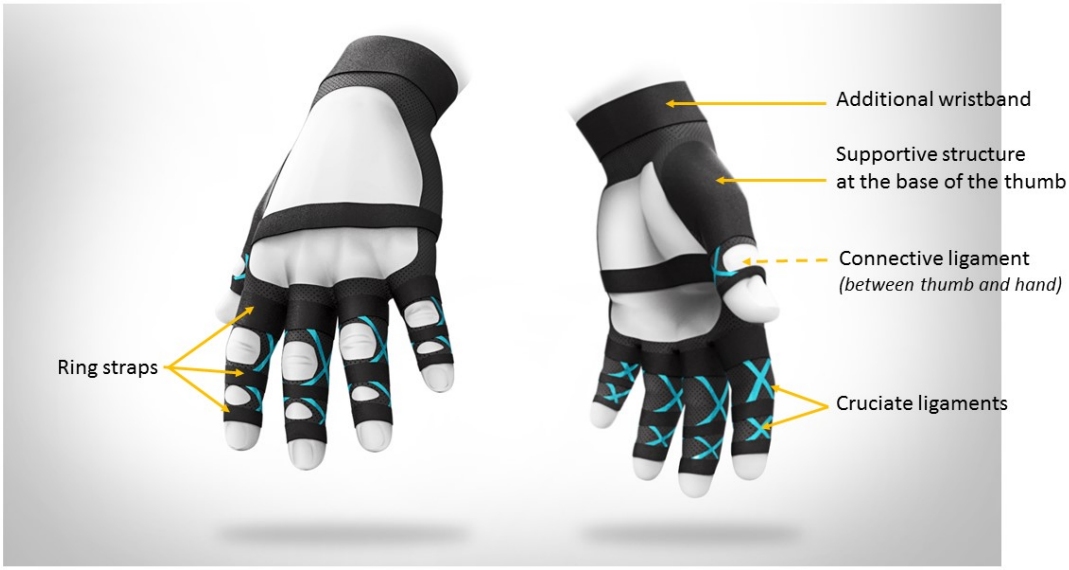

Figure 1. Functional components of the patented sports glove

The benefits of each of these features are further explained here:

- the ring straps in the middle of each phalanx of the finger improves grip strength and supports the inner anatomy structure
- the cruciate ligaments, positioned lateral to each finger joint minimizes collateral ligament rupture and provides additional stability to the joint
- supportive structure at the base of the thumb and connective ligament for the metacarpophalangeal joint and to prevent ulnar collateral ligament injury of the thumb
- an additional wrist band for wrist protection

Furthermore, no textile material should be present at the fingertips and above the joints, respectively to maintain sensation of the fingertips and mobility during exercise.

The process technology that will be used to ultimately produce the glove is not fixed yet but seamless circular knitting is the most likely.

3. TEST SETUP AND PRELIMINARY RESULTS

An artificial finger was 3D printed, mimicking the restricted movement of the joint in lateral direction. The INSTRON tensile strength tester is used to load the tip of the finger without and with the manufactured prototypes. The load required to displace the fingertip 12 mm down is measured.

Figure 2. Test setup: artificial finger in INSTRON tensile tester

Four initial prototypes, as shown in Figure 3, were manufactured based on inelastic (A01 and A02) and elastic (A03 and A04) narrow fabrics used as cruciate ligaments. Prototype A04 is constructed on top of a glove, so has no ring straps.

Figure 3. Four prototypes: A01 (top left) and A02 (top right) have inelastic cruciate ligaments
A03 (bottom left) and A04 (bottom right) have elastic cruciate ligaments

From Figure 4 it is clear that with the support of the cruciate ligaments, the finger joint can indeed sustain more load, with the open woven structure performing the best. As second best are the elastic narrow fabrics and the other inelastic fabric performs worst. Sample A02 performed worst. This was attributed to bad positioning of the cruciate ligament bands, indicating that very accurate positioning of the bands will be required for effective support.
The support that is provided by the presented initial prototypes is only 0.2-0.7 N which is far from what is needed to protect the joint. With the lessons learned from the initial prototypes, a second set of prototypes is being constructed, aimed at offering a support up to 10 N, which we consider the minimum required for effective support of the joints, **[4,5]**.

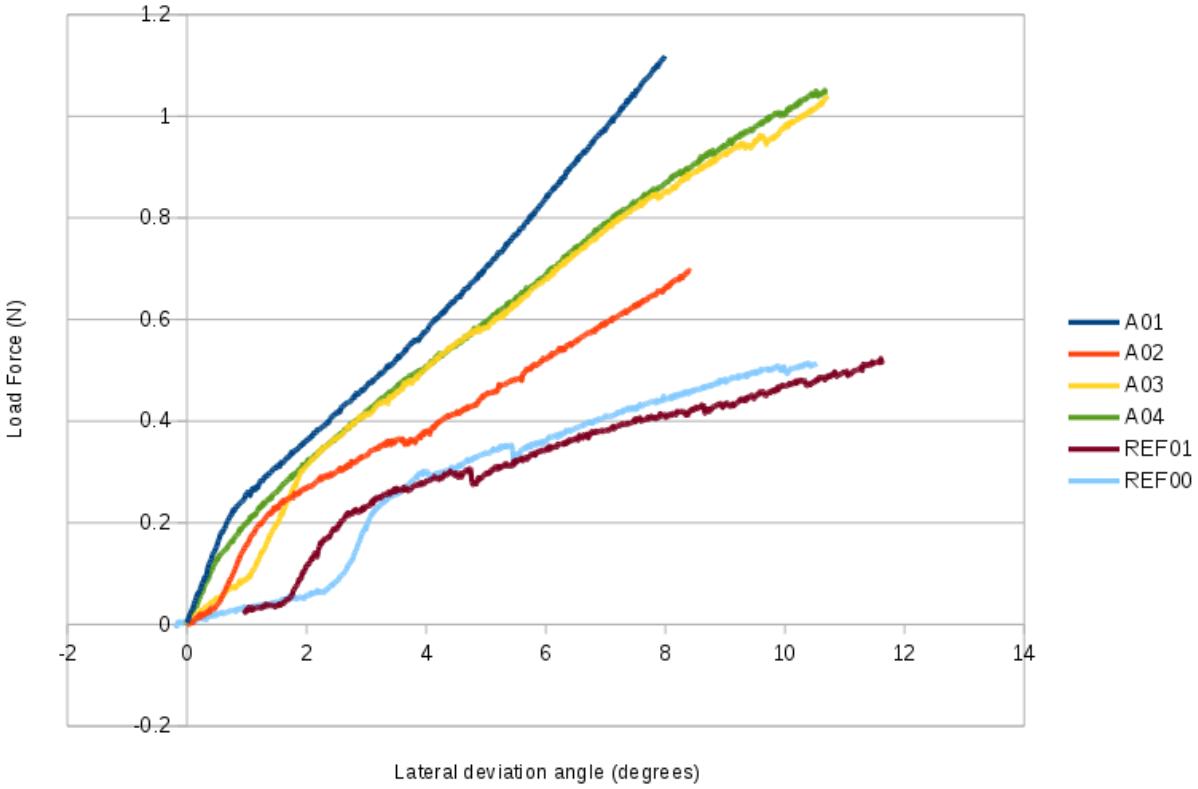

Figure 4. The load needed to displace the fingertip 12 mm. REF means the bare finger without any protection

4. CONCLUSIONS

Sportsmen practicing contact sports like Brazilian jiu-jitsu or judo often suffer from finger injuries. The main current alternative available is taping the hands and fingers. However, taping has various disadvantages. The purpose of the patented Exoligamentz glove presented in this paper is to overcome the disadvantages of tape.
Preliminary results have proven the efficiency of a supporting cruciate ligament at the finger joints. Improvements will be made to reach 10 to 30 N of extra support. However, the main challenge lies in finding the suited production technology.

5. REFERENCES

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