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3D printed tourniquet: Day 2 of Gaza field trials ends badly (May 14)

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WARNING: Graphic images and content.

A few days ago, I wrote about our first day of field trials for an open source 3D printed tourniquet in Gaza. The Glia team worked overtime to address and fix the problems we identified. Thanks to help from the 3D printing, engineering and open source communities, we got lots of feedback and felt that we were ready for today.

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Good news first: The tourniquets worked well

The only bit of good news in this report has to do with the tourniquets. We left the packaging issues to later (Failure #2), and instead focused on the mechanical issues we identified (Failures #3 and #4). We pulled all old models and tested buckles to see if they would break—we thought this issue was a low likelihood of recurrence, even though we will be testing alternative buckle designs later.

The tourniquets worked well. We recovered the 100 units given to Hayat Center for use in the field, giving us an inventory of 200 deployed units. One hundred units were distributed in the field today, and one hundred held in reserve for May 15. Seventy-eight (78) tourniquets were deployed to patients who met criteria. There were no failures of the device in any cases.

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Failure #1 rules supreme: Unsafe conditions for medical personnel

Failure #1 in our previous report was that “There are no ideal operating conditions”. This made optimizing the device important. We did that as much as we could.

The unspoken part of this is optimizing safety. To ensure the safety of first responders, we all dressed in clearly identifiable medical garb. Most paramedics wore fluorescent high visibility jackets. I wore a hospital green top and bottom so I could both be identified as medical staff and a physician.



Paramedics wearing clearly identifiable clothing. Source L: Unknown R: Ayman Mansour

Despite our efforts to clearly identify ourselves as first responders, several of our medical team were wounded by Israeli live fire. One paramedic, Musa Abuhassanin, was killed while attempting a victim rescue under fire. One hour before he was shot in the thorax and killed, Musa was one of my rescuers when I was shot by live ammunition. I sustained a moderate injury to my left leg and a minor one to the right leg. Musa was also the paramedic who discovered and reported the failed buckle in our previous report. He had a great laugh and was a good paramedic.



Left: Civil defense paramedic Musa Abuhassanin. Date and Source unknown **Middle:** Abuhassanin rescuing a wounded patient shortly before his death. Gaza, May 14, 2018 **Right:** Abuhassanin is being treated by his colleagues. He is still wearing his high visibility vest, May 14, 2018. Source unknown

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Anatomy of my gunshot wound

I am still collecting details of the shootings of Musa and other members of the medical team. In the meantime, I can contribute an account of my injury. The scene in eastern Gaza was bad since early morning. There was so much live fire that the first responder services stood outside the protest area and only approached when needed. In general, we approached with high visibility clothing and hands up until we arrived at the incident. We did not run to patients, but we definitely ran out. We did not attempt to tourniquet or treat patients on site.



Paramedics approach a wounded protester with hands up and high visibility vests, May 14, 2018. Source unknown

I was shot toward the end of the morning, and we had already run out of our first supply of tourniquets. I had just resupplied with 8 units, one of them unpacked in my pocket. We were standing well away from the main protest area. The snipers in the three sniper outposts all had clear views of us.

There was no fire or smoke near us. We were standing still, and I was facing in a southerly direction talking to a colleague. The snipers were situated east of us. I was wearing visible full hospital greens. There was no active shooting from the Israelis immediately before or after. There were no protesters in our immediate vicinity.



Snipers' view of protesters in Gaza, May 14, 2018. Source: Jack Guez/AFP/Getty Images

I heard a loud bang and found myself on the ground. The bullet had entered my left proximal calf on the lateral side, exited on the medial side (moderate) and pierced my right knee superficial to the patella (minor). I yelled fuck.

The paramedics initiated treatment within 5 seconds, and asked me if I needed a tourniquet. The wound had about 100cc of blood lost on the scene, but didn't look to be bleeding dangerously. I believe that I was shot with a regular bullet and not the exploding bullets that are causing severe injuries reported today and on other days. Knowing the shortage, I stopped the application of the tourniquet, and was instead given a pressure dressing. There was no live fire before or after my incident.

I was transported to hospital, stabilized and discharged after X-Rays showed no bony injury.



Top Left: Entry wound in my left proximal calf. Gaza, May 14, 2018. **Top right:** Exit wound showing likely non-exploding bullet. Gaza, May 14, 2018. **Bottom Left:** Pressure bandages on wound, with apologies to LHSC for getting bullet holes in their pants. Gaza, May 14, 2018. **Bottom Right:** Exit wound from exploding bullet in left proximal calf of child, shot in similar location. Note lack of formal or improvised tourniquet due to time constraints. Gaza, May 14, 2018.

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Conclusions

At the time of writing, there were 52 people killed and 2410 wounded during today's peaceful Palestinian protests. 1,204 were struck by live ammunition. Seventeen (17) paramedics were wounded and one killed.

The tourniquets appear to be feature-complete and usable as is. We will

continue to monitor and develop the tourniquets, especially thanks to the community support offered in improving the design.

However, it is clear that conditions remain suboptimal for tourniquet deployment by paramedics at this time. One possible solution is the wide deployment and routine training of the general Palestinian population in the use of tourniquets, such as in Basic Life Support (BLS) courses.

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Dedicated to the brave women and men of Gaza's paramedic and front-line response teams.