

No *Guts* No Glory! Redesign of Kneeling Rolls used in Elite Marksmanship Competition for improved Performance

Colleen Moretz and Dr. Angela Uriyo

West Virginia University

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Marksmanship is one of the oldest Olympic sports dating back to the 1896 Olympic Games in Athens. In the 50-meter Olympic rifle competition elite marksmen fire a .22 caliber long rifle at targets in the (a) kneeling, (b) prone, and (c) standing positions (International Shooting Sport Federation, 2018). Marksmen compete outdoors and contend with environmental factors, which must be minimized for consistent performance and medal contention. This quest for consistent accuracy and precision is what led a 2016 Rio Olympics gold medalist to search for a better kneeling roll.



Figures 1&2.
Kneeling roll in use during marksmanship practice

During competition, 30 percent of the shots are taken from the kneeling position; a complicated position as marksmen must maintain their arms, legs and foot in an awkward pose for as long as an hour (Rachel, personal communication, May 2, 2019). In this pose, a kneeling roll is placed above the ankle to support the right foot and provide and maintain postural balance (see *Figures 1&2*). Kneeling rolls are inexpensive empty fabric cylinders (approximately 25 cm long and 18cm in diameter). Based on preference, marksmen fill them with cork, rubber pellets, rice or wood shavings (SSUSA Staff, August 28, 2017).

In Olympic competition, every point matters. The diameter, materials used to fill the kneeling roll and the level of fill matters greatly. Underfilled or overfilled kneeling rolls vary in diameter. This impacts a marksman's ability to use their right shoe for proper postural stabilization affecting the sight picture on their rifle. The sight picture is the image a marksman sees when the sights are aligned correctly with the target. Ideally, a marksman in the kneeling position needs to settle and maintain a stable point-of-aim

position for prolonged periods of time, without constant adjustments to their kneeling roll.

Current kneeling rolls dimensions change as fill material shifts, making the kneeling position uncomfortable and unsustainable. Thus, the purpose of this study was to improve a marksman's accuracy and precision by developing a kneeling roll that provides better stability and comfort during competition.

A user-centered design process was used from prototyping through evaluation. Qualitative interview data informed prototype concept fit (Sanders, 2002).

A twenty-two-year-old female Caucasian and 2016 Olympic Gold Medalist participated in this study. Research began with user interviews to define the problem and the context in which the kneeling roll was used. During the second stage, researchers took into account the International Shooting Sport Federation (ISSF) requirements regulating specialized equipment used during competition. In the third stage, drawing on the experiences and knowledge of the user, the researchers and user brainstormed possible design solutions. Ideas were then sketched, patterns drafted and two prototypes were constructed.

Current kneeling rolls consist of two parts, an outer shell made of a soft durable fabric to which the filling material is added. The researchers created a third component to the kneeling roll. This interior structure was made of cotton canvas, and buckram reinforced cylindrical edges. For easy access to the interior structure, the zipper on the outer shell was relocated from the bottom to the side of the cylinder.



Figure 3. Filling compartments with plastic beads

To control and stabilize the diameter of the kneeling roll during use, the interior structure was designed with three independent compartments. The interior structure was sewn to the outer shell to prevent collapse during use. The three independent compartments provided better control of fill levels and constrained shifting of fill material, enabling the kneeling roll to retain its customized shape (see *Figure 3*). Black velcro was sewn to the top opening of each compartment allowing independent access to each interior compartment when the outer shell was unzipped, enabling user adjustments based on need and context.

For structural integrity of the compartments and durability, the interior structure was constructed from cotton canvas and each cylindrical end reinforced with buckram between layers of cotton



Figure 4. Cylindrical end reinforced with buckram

organdy (see *Figure 4*). The user needed stiff cylindrical ends to support the ankle. In the evaluation stage, the user filled the prototype with her preferred fill material and tested the kneeling roll. The design process proceeded in a nonlinear manner, as user requested refinements necessitated return to ideation. A second prototype was developed which the user tested during target practices. The researcher observed a successful usability test, and after much testing the user is currently using this prototype during her international rifle shooting competitions.

This exploratory study demonstrates the importance of the user's role during the design process. Future research will continue with usability trials with other users to confirm the effectiveness of the redesigned kneeling roll in a variety of contexts. The end goal is to present a field tested prototype to a manufacturer for commercialization.

This study also suggests the ability for apparel researchers to address textile-related problems in nontraditional places. In doing so, they help improve the lives and livelihoods of individuals, while redefining the boundaries of our discipline by making it more relevant to solving current problems.

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