MEASUREMENT OF SHIELDING STIFFNESS IN ICE HOCKEY

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Background and Motivation

- Concussions are common in ice hockey, and up to 37% of cases are caused by the head striking the shielding (or "glass") [1].
- Evidence suggests that the risk for traumatic brain injury depends on the stiffness of the colliding objects [2].
- Previous analysis reported that flexible acrylic shielding reduced the risk of injury by 29% compared to tempered glass [3].
- The shielding is supported by cap rail at the bottom and vertical posts. In this study, we examined how the stiffness of the shielding is influenced by the proximity to cap rail or posts.

Objectives

To determine whether the stiffness of the shielding relates to location relative to cap rail and post.

Methods

- Data were collected at the Bill Copeland ice rink, which has 16 mm thick tempered glass shielding and aluminium support posts.
- The test setup is shown in Figure 1.
- Force and displacement were measured with a load cell and a linear variable inductance transducer (LVIT) (Figure 1).
- We incrementally tightened the strap, measuring force and displacement in the range of 0-1000 ± 200 N (Figure 2).
- Measures were acquired along the side, corner and end of the rink at three heights from the cap rail and at two horizontal locations: the middle of the panel and as close as possible (10 cm) to the post.
- For each location, we performed three repeated trials and used ANOVA to compare stiffness between locations.

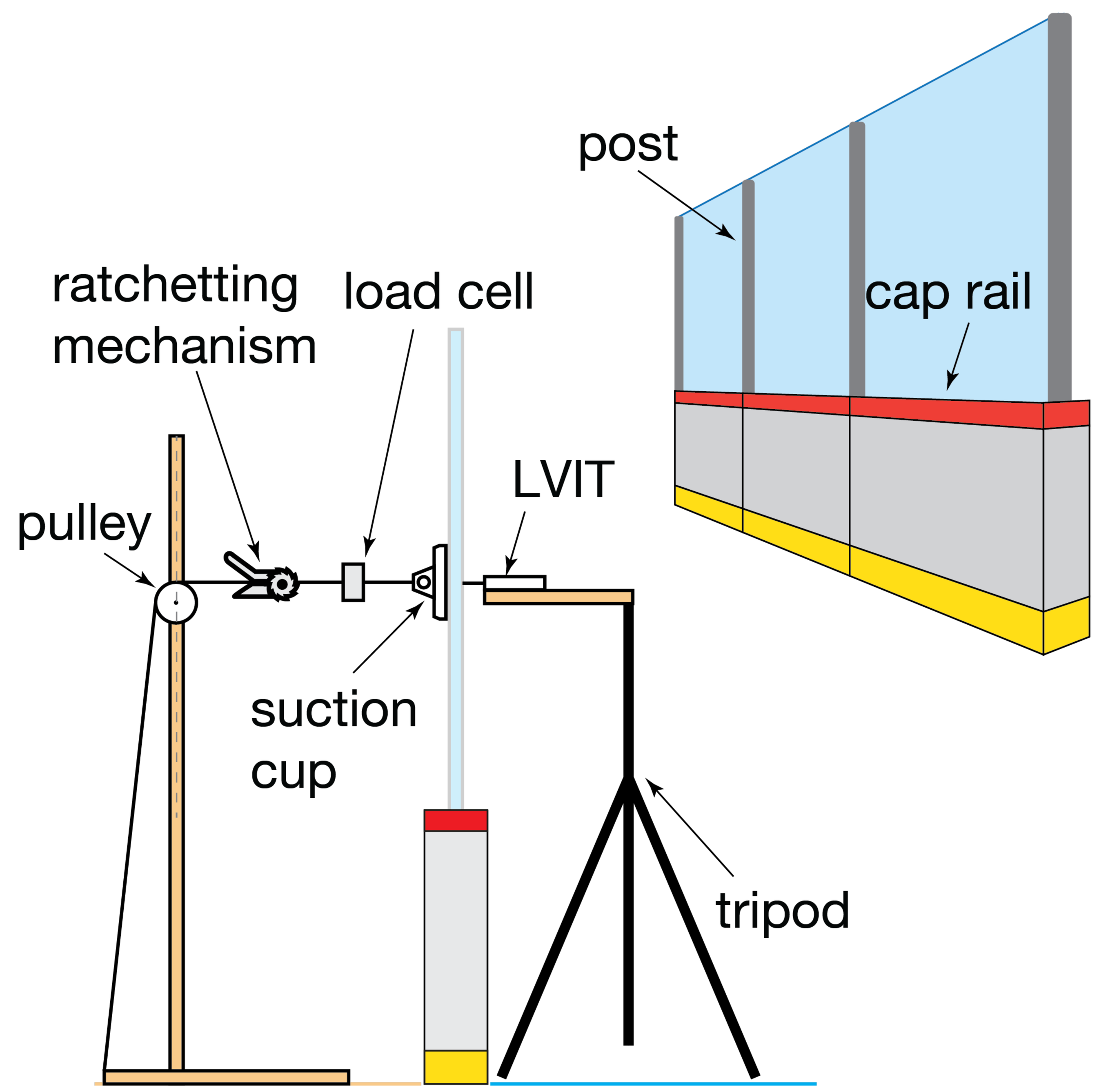

Figure 1: On ice test setup used for measuring the stiffness of shielding and a diagram of dasher board.

Results

The stiffness of the shielding varied between 60.0 and 290.8 kN/m.

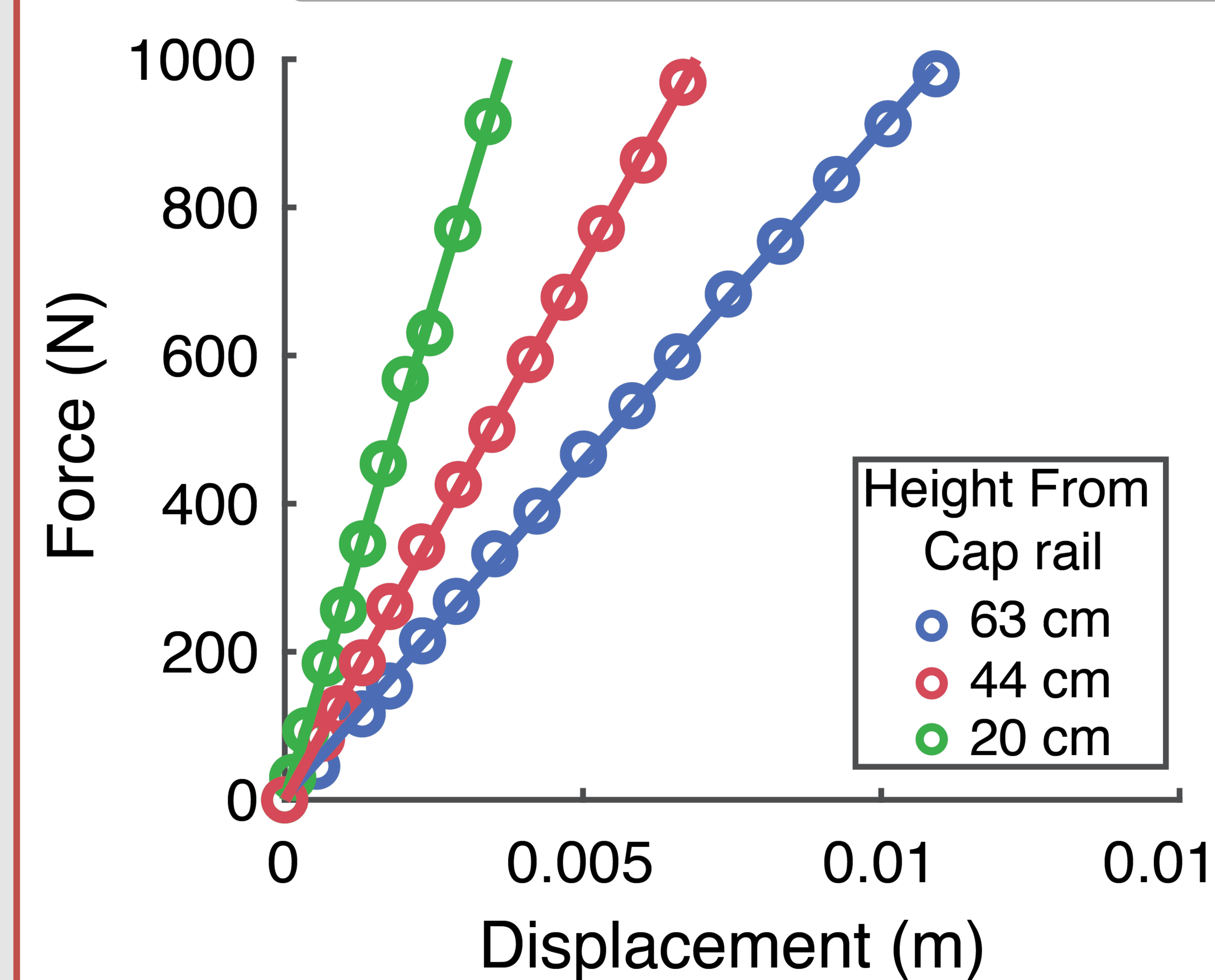

Figure 2. Force-deflection graph from data collected close to post along the end boards.

Shielding stiffness at a height of 20 cm was 170% greater than at a height of 63 cm and 55% greater than at a height of 44 cm.

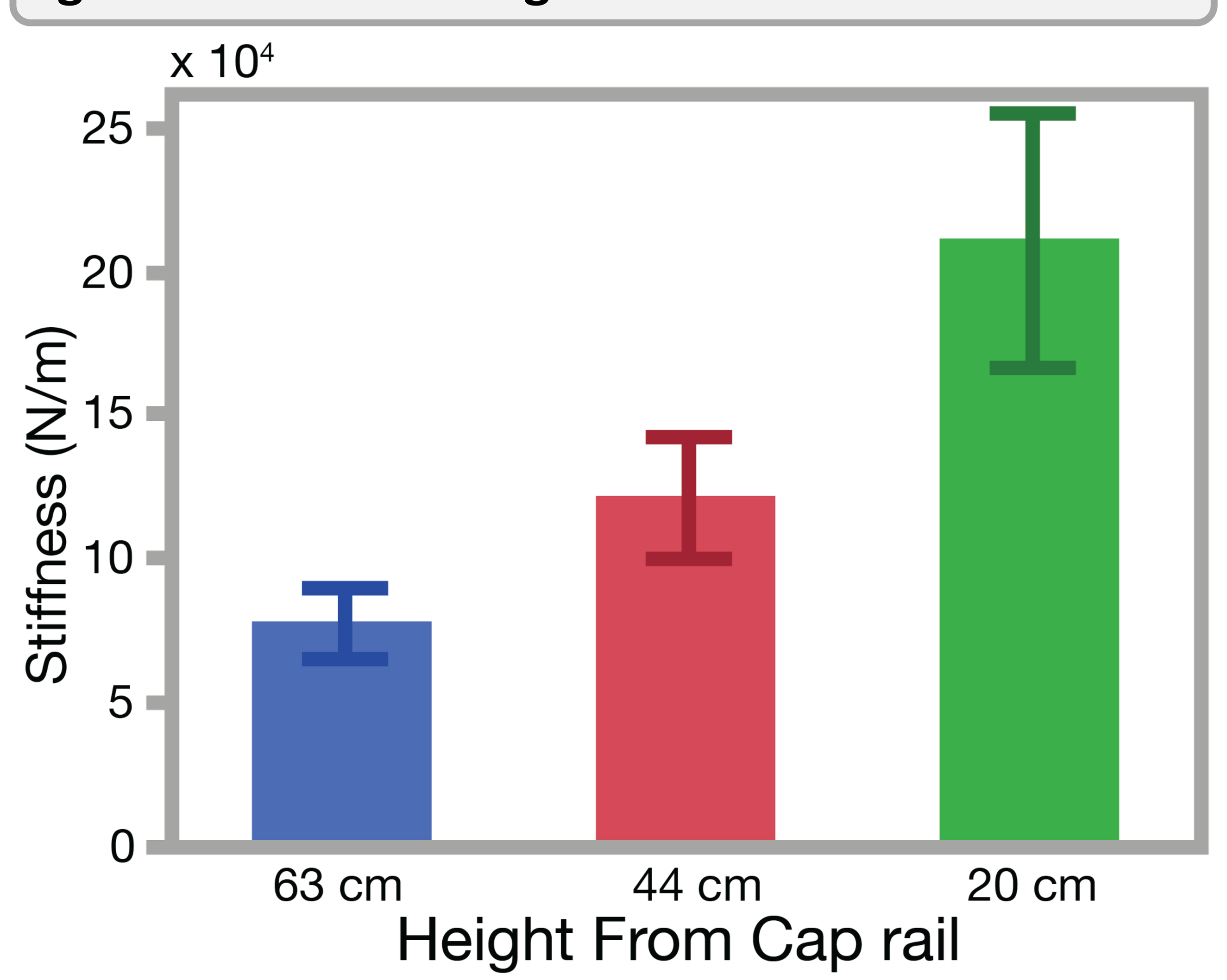

Figure 3. Average stiffness and SD for three heights above the cap rail.

Shielding stiffness did not depend on the horizontal position relative to the post (p = 0.9614).

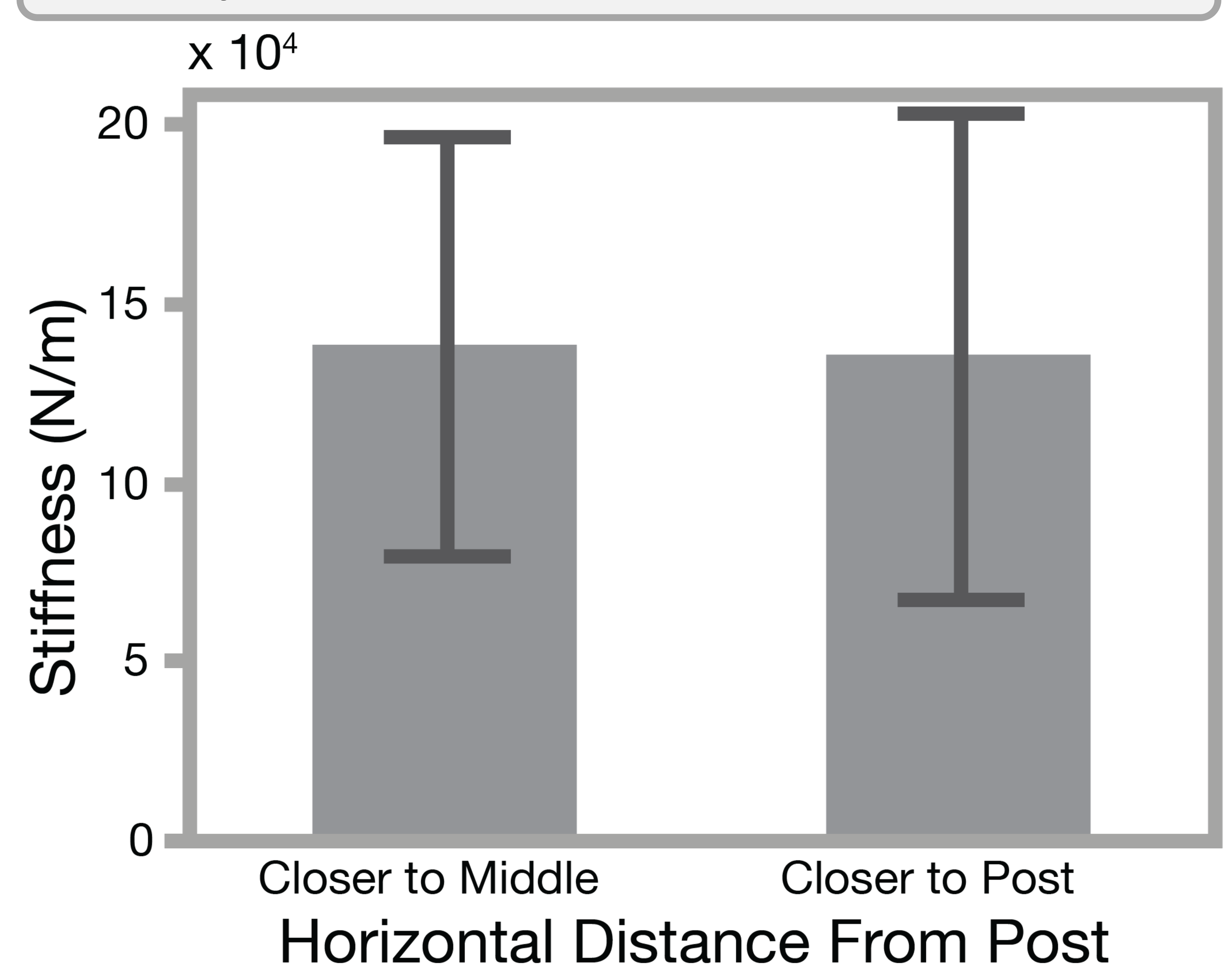

Figure 4. Average stiffness and SD for two horizontal distances from the closest post.

Shielding stiffness did not depend on the location of the shielding panel on ice (p = 0.0572).

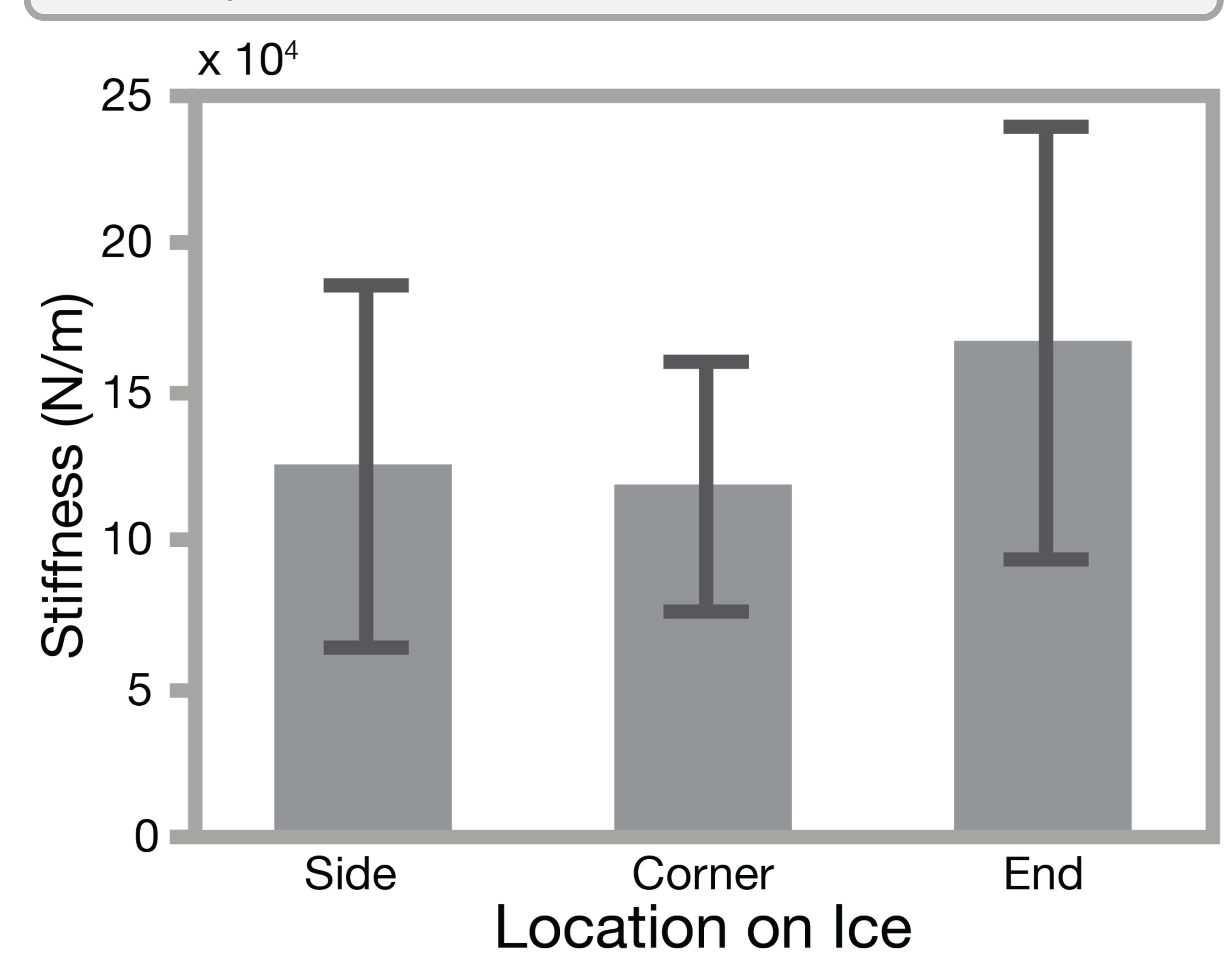

Figure 5. Average stiffness and SD for three locations around the rink.

Conclusion

- Using a portable test setup, we found the stiffness of the tempered glass shielding in an ice hockey rink varied between 60 and 281 kN/m.
- We observed that shielding stiffness varied with the height of the impact (proximity to the cap rail) but remained consistent across different horizontal positions (proximity to the post).
- Our results provide evidence to inform improvements in the design and regulation of shielding to reduce brain trauma during ice hockey.

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References

[1] Hutchison et al. (2015), *Br J Sports Med.*
[2] R. A. Oeur et al. (2019), *Proc IMechE Part P: J Sports Engineering and Technology*
[3] M. Tuominen et al. (2015), Br J Sports Med.

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