

INTRODUCTION

In recent years, increasing attention has been directed toward the influence of the cervical region on **impacts sustained in contact sports**.

Football is one of the most extensively studied sport due to the high frequency of head impacts experiences by athletes. However, **few studies have investigated the effects of repetitive head impacts on cervical function**, particularly regarding which cervical movement are affected and the mechanisms underlying these changes.

AIM

- Investigate statistically significant changes in cervical range of motion in university-level varsity football athletes throughout a football season.
- Investigate clinically significant changes in cervical range of motion in university-level varsity football athletes throughout a football season.
- Investigate whether an association exists between cervical range of motion changes and heads impacts metrics.

METHODS

Participants
University-level varsity football athletes from University of Montreal's team.

Time Points
Pre-, mid-, post-season

Directional Change Scoring
Cervical motion changes were scored as improvement, no change, or deterioration.

Mesurement

Sign Test Analysis
Sign tests assessed whether observed directional changes differed from chance.

Ordinal regression Modeling
Ordinal regression explored participant-level predictors influencing changes, especially focusing on cervical extension outcome

Cervical range of motion

- Digital goniometer
- Left/Right rotation;
- Flexion/Extension;
- Left/Right lateral flexion.

DEMOGRAPHS

Table 1. Participants characteristics

Participants (n)	22
Years of experience [mean±SD] [10,09 ± 3,40]	
Age (y.o) [mean±SD]	[22,57 ± 1,29] years old
Height (lbs) [mean±SD]	[238,36 ± 81,04]
Weight (lbs) [mean±SD]	[231 ± 5,97]
Line players (n)	13
Skills players (n)	9

RESULTS

Table 2. Cervical range of motion changes across football season

	Pre-season (°) Δ	Mid-season (°) Δ	Post-season (°) Δ	p value
Flexion	64.61	68.09	63.35	0.051
Extension	70.41	70.44	63.97 ↓	0.02
Lateral Flexion (Right)	55.59	57.92	55.41	0.159
Lateral Flexion (Left)	58.65	53.08	51.15 ↓	0.001
Rotation (Right)	84.76	88.00 ↑	84.61	0.049
Rotation (Left)	87.26	87.17	83.88	0.053

Table 3. Clinically significant changes in cervical range of motion

	Improvement	Deterioration	No change	p value
Flexion	2	8	11	0.11
Extension	1	10	12	0.012*
Lateral Flexion (Right)	1	4	18	0.38
Lateral Flexion (Left)	2	5	16	0.45
Rotation (Right)	2	3	16	0.69
Rotation (Left)	1	4	17	0.38

Changes in cervical range of motion were analyzed using sign tests. A significant decrease was observed for cervical extension ($p = .012$), with more participants demonstrating deterioration than improvement. No significant changes were found for cervical flexion, lateral flexion (right and left), or rotation (right and left), although a consistent trend toward deterioration was observed across most movements.

Table 4. Change distribution in clinically significant changes in cervical range of motion

Although ordinal regression analyses were performed to assess the association between predictors and the direction of change, no significant effects were detected ($\chi^2(10) = 15.16, p = .126$). These results are likely influenced by limited statistical power, given the small sample size and the low frequency of observed changes.

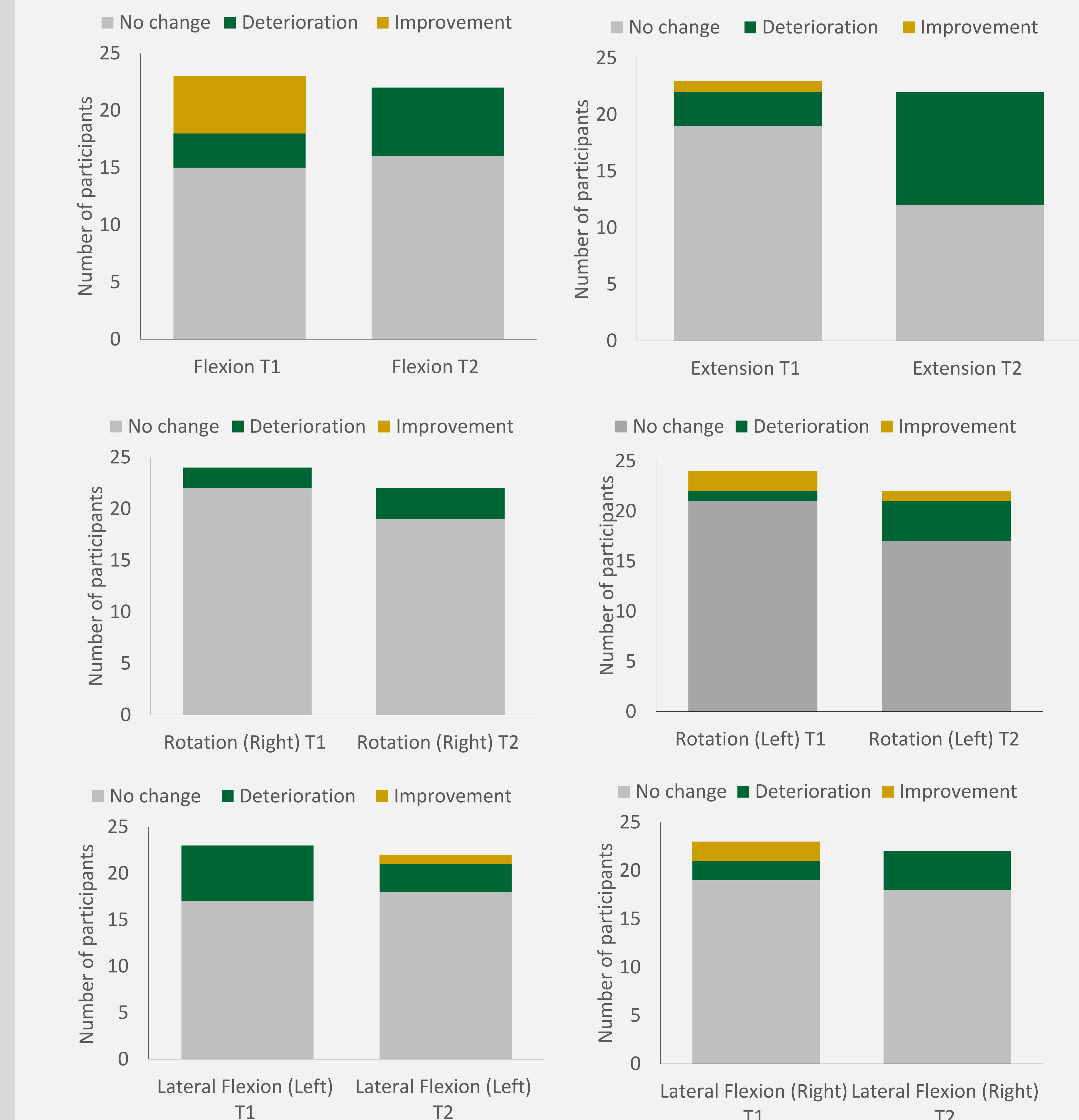
CONCLUSION

Cervical range of motion: Extension and left lateral flexion were the cervical movements most affected throughout the university football season. However, a clinically significant difference was observed only for cervical extension.

In conclusion, changes in cervical range of motion among university-level varsity football athletes are not solely predicted by the number of impacts or the cumulative force sustained throughout the season. Other metrics, such as rotational forces and impact location, must also be considered.

Furthermore, our findings suggest that cervical function may play a protective role against head impacts. Therefore, it is essential to identify the factors contributing to these changes in order to support the development of safer sports practices.

Table 4. Change distribution in clinically significant changes in cervical range of motion



REFERENCES

- Mihalik, Jason P., et al. "Measurement of head impacts in collegiate football players: an investigation of positional and event-type differences." *Neurosurgery* 61.6 (2007): 1229-1235. Patricios, J. S., Davis, G. A., Ahmed, O. H., et al. (2023). Introducing the Sport Concussion Office Assessment Tool 6 (SCOAT6). *British Journal of Sports Medicine*, 57(11), 648–650. <https://doi.org/10.1136/bjsports-2023-106860>
- Montenegro, Philip H., et al. "Cumulative head impact exposure predicts later-life depression, apathy, executive dysfunction, and cognitive impairment in former high school and college football players." *Journal of neurotrauma* 34.2 (2017): 328-340.
- Schmidt, Julianne D., et al. "The influence of cervical muscle characteristics on head impact biomechanics in football." *The American journal of sports medicine* 42.9 (2014): 2056-2066.
- Elliott, Jonathan, et al. "Injury reduction programs for reducing the incidence of sport-related head and neck injuries including concussion: A systematic review." *Sports medicine* 51.11 (2021): 2373-2388.
- Garrett, Joel M., et al. "The relationship between neck strength and sports-related concussion in team sports: a systematic review with meta-analysis." *Journal of orthopaedic & sports physical therapy* 53.10 (2023): 585-593.
- Stenneberg, Martijn S., et al. "Variability of Active Cervical Range of Motion Within and Between Days in Healthy Participants: A Prospective Observational Study." *Journal of Manipulative and Physiological Therapeutics* 46.2 (2023): 125-131.
- Smith, Laura, et al. "Performance of High School Football Players on clinical measures of deep cervical flexor endurance and cervical active range of motion: is history of concussion a factor?" *International journal of sports physical therapy* 11.2 (2016): 156.
- Nyland, John, and Darren Johnson. "Collegiate football players display more active cervical spine mobility than high school football players." *Journal of athletic training* 39.2 (2004): 146.