Cervical spine injury in rugby: is buckling the most likely injury mechanism?
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AIM
Investigate the effect of i) neck muscle activation level, and ii) neck flexion angle on individual vertebral loading due to misdirected rugby scrum loads.

METHODS
• Three-player rugby union front row engaged against a scrum machine with an instrumented anthropometric testing device (ATD) (Hybrid III, Humanetics, Germany), (Fig 1).
• Forward dynamic simulations (OpenSim 3.3, Stanford University, USA) using the population specific “Rugby Model” [1] were run by prescribing experimental data.
• Impact force and moment data from ATD at 500 Hz
• EMG bilaterally from sternocleidomastoid and upper trapezius at 2 kHz (Delsys Trigno, Delsys Inc, USA).
• Joint Reaction Analysis was performed on C4, C5 and C6 vertebral levels

RESULTS
• Timing of peak compression was at 28-30 ms whilst peak impact load at 80 ms
• Angles greater than 20⁰ increased compression on C4-C6 (Fig 2).
• Higher muscle activations increased cervical spine compressive load but decreased shear on C5 and C6

CONCLUSION
• Contrary to previous studies [2] our results showed a dual scenario: i) muscular pre-activation and higher levels of stiffening generates greater compressive forces potentially predisposing to injury, but ii) they can also decease the shear load on C5 and C6.
• Peak force timings support that neck injuries occur significantly earlier than cervical hyperflexion [2].

REFERENCES