Critically Appraised Topic (CAT) – Trauma and Environmental Conditions in Paramedic Practice

Title: C-spine movement comparison of self-extrication versus device assisted extrication in motor vehicle accidents

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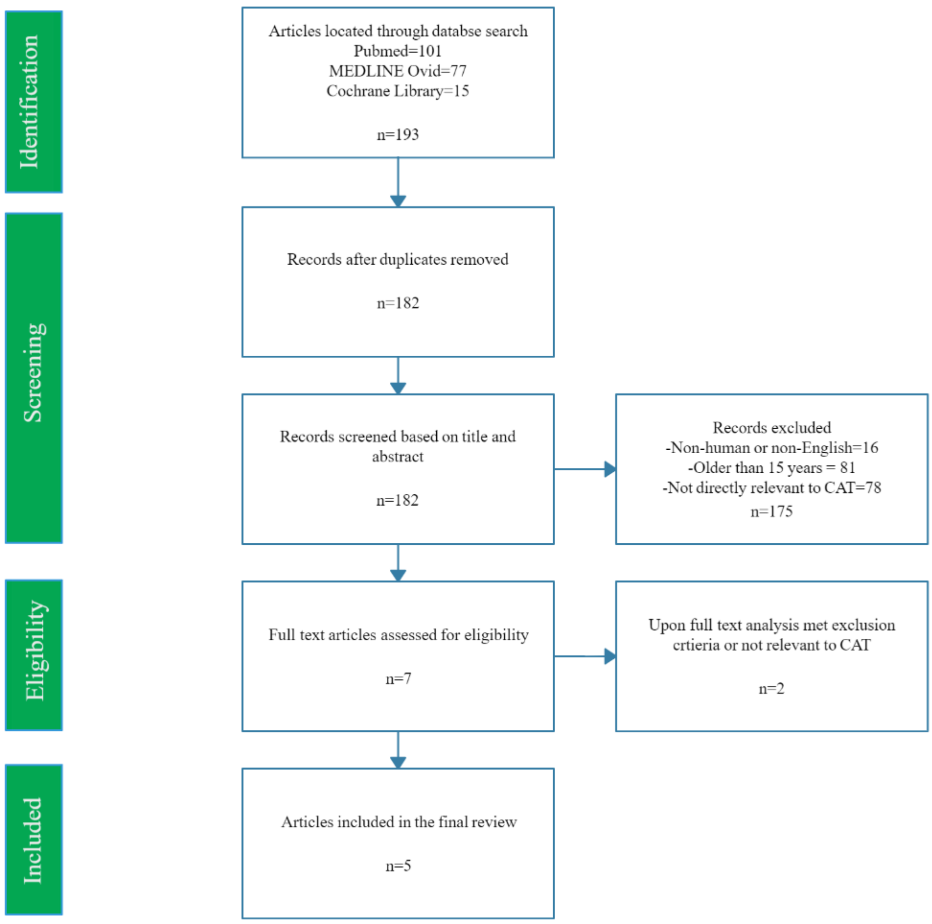
Clinical Scenario: You are called code one to a moderate speed car versus tree road traffic crash. On arrival you find a single conscious patient trapped in the vehicle wrapped around the tree. The air bags have been deployed, and the driver's door cannot be opened. You have called for additional resources to aid in extrication and the scene has been deemed safe to proceed. On examination, you note that the 56-year-old patient is Glasgow Coma Scale 15, has bruising to the chest, pain on inhalation, deformity and pain to right arm, 3cm head laceration and 4/10 pain around the C4-5 area. Access to the patient has been achieved, and method of extrication must be determined.

Patient, Intervention, Comparison, Outcome (PICO) Question: In patients involved in motor vehicle accidents requiring extrication, does self-extrication or device assisted extrication have reduced c-spine movement?

Rationale: A vital factor of extrication that must be considered is c-spine movement. This is detrimental in patients involved in motor vehicle accidents and measures need to be applied to avoid secondary injury. One aspect that can reduce c-spine movement is choosing the appropriate extrication method.

Search Methodology: The search was conducted using the medical electronic databases of Ovid MEDLINE, PUBMED and Cochrane. Searches were also conducted on Embase and CINAHL but yielded no additional relevant articles. The MeSH headings and keywords used were self-extrication, extrication and C-spine. These were used individually and in combination to identify relevant articles. Studies were included if they related to the extrication of patients involved in motor vehicle accidents and were excluded if they were not human studies, written in another language, older than 15 years, literature review and were not relevant to the CAT.

Search Results: 193 articles were located with 5 relevant articles meeting the inclusion criteria from 2013 to 2019. There were 188 articles that met the exclusion criteria which is outlined in a Prisma flow diagram.



Citation	Study Population	Study Design	Outcome	Results	Strengths and Limitations
(Dixon, O'Halloran, Hannigan, Keenan, & Cummins, 2015)	Adult volunteers (n=16) Located in Ireland.	Cross-sectional controlled study. Biomechanical analysis The equipment groups included -Self-extrication: without collar -Self-extrication with collar -Long spinal board -Short extraction jacket	Controlled self-extrication causes less movement of the cervical spine than extrications using traditional pre-hospital extraction equipment	Movement from neutral in-line (°): Self-extrication without collar: 13.33°±2.67° Self-extrication with collar: 14.93°±1.51° Device assisted extrication Mean movement: 17.60°±3.15° The study also found a correlation with heavier individuals and more cervical movement.	(+) Controlled study. (+) Statistically significant findings, which support the findings of the previous proof of concept study. (+) Participants had no previous knowledge of extrication techniques. (+) Recent study. (-) Small sample size- 15- Considered adequate. (-) Simulated non-injured patients that would not have the same protective mechanisms (Self-splinting). (-) Power calculation was not possible- No previous studies with sufficient data. (-) Clinical significance is lacking as the correlation between degrees of cervical spine movement and injury prediction pattern remains unproven. (-) Human error may have skewed results
(Engsberg et al., 2013)	Simulated adult volunteers (n=10) Located in United States.	Repeated measures study. Two EMS personnel extricated the driver using one of the four techniques -Unassisted, Unprotected- No collar -Unassisted, Protected- collar applied -Assisted, Protected- collar applied -Spinal long board.	Significant decrease in movement for all planes of motion when the driver was extricated using the unassisted, protected technique.	Unassisted Unprotected: -Flexion-extension: 22.5° -Lateral flexion: 22.5° -Rotation: 33° Unassisted Protected (Collar): -Flexion-extension: 12.5° -Lateral flexion: 12.5° -Rotation: 17° Assisted Protected (Collar): -Flexion-extension: 24.5° -Lateral flexion: 24.5°	(+) Ten participants were deemed adequate number for power analysis. (+) Data showed motion trends including during procedures such as collar application, pivoting in seat and walking. (+) Controlled study. (-) Simulated non-injured. patients that would not have the

		-Assisted, Protected- collar applied -Kendrick Extrication Device		-Rotation: 23° Assisted Protected (KED) -Flexion-extension: 31° -Lateral flexion: 31° -Rotation: 27.5°	same protective mechanisms (Self-splinting). (-) Participants recruited by word of mouth, four of which were EMS personnel so had prior knowledge of extrication techniques. (-) Movement of the surface markers had some tracking difficulties which may have altered the results. (-) Only the planar range of motion was quantified. (-) Clinical significance is lacking as the correlation between degrees of cervical spine movement and injury prediction pattern remains unproven. (-) Human error may have skewed results
(Krell et al., 2006)	Adult volunteers in rigid cervical collars (n = 31)	Prospective, non-randomised, crossover study	Long back board (LBB) had 6-8° (3-5 times) greater motion in sagittal, lateral, and axial plains during application compared with Ferno Scoop Stretcher (FSS)	LBB: • Occiput:58mm (p=0.596) • Thoracic spine:64mm(p=0.001) • Sacrum:40mm(p<0.001) • Heels:64mm(p=0.002) • Overall:58mm (p<0.001) FSS • Occiput:61mm • Thoracic spine:78mm • Sacrum:72mm • Heels:81mm • Overall:75mm	(+) Statistically significant data. (+) Prospective nature. (+) Analysis of variance used (ANOVA). (-) non-randomized. (-) Simulated non-injured patients that would not have the same protective mechanisms (Self-splinting). (-) Dated study (>5years). (-) Sensors may have moved on skin during manoeuvres. (-) Controlled setting. (-) Human error may have skewed results

(Wampler et al., 2016)	Healthy adult volunteers (n=9)	Randomized, unbalanced, 2-period 2-treatment 2-sequence crossover healthy volunteer study.	Study showed that during transport, Long Spine Board (LSB) caused increased movement focusing torque to the cervical area compared to the stretcher. Study also mentioned the negative implication of LSB use: • Pain • Respiratory compromise • Increased anxiety • Injuries in form of skin breakdown.	Mean lateral movement during transport: Stretcher: • Head:0.5cm • Chest:1.2cm • Hip:1.2cm LSB: • Head:0.97cm • Chest:2.22cm • Hip:1.88cm	(+) Randomised study (+) First study of its kind (+) Recent study (<5years) (-) Simulated trial (-) Healthy volunteers -creating bias (self-splinting would not have occurred) (-) Small population size (-) Not sufficiently powered or comprehensive (-) Low speed transport testing (-) Only evaluated gross lateral movement (-) Movement was only measured across a single plane (-) Focused on transport only (-) Human error may have skewed results
(Hauswald, 2013)	N/A	Reconceptualization	The following treatments are irrational: • Backboards for transport • Immobilisation of ambulatory on backboards Study recommended these treatments should be removed; decreasing time to definitive treatment, ischaemic tissue damage and simplify airway management.	Biomechanics: Bone fragments can only cut the cord once the normal (near zero resistance) range of motion is exceeded and force is directed at the injured site. Generally, takes 2000-6000 Newtons of force to fracture cervical spine. Whereas bending the head off the stretcher will generate 40 newtons. Anatomy and physiology: Most spinal injuries are biomechanically stable in short term and only become unstable as tissue oedema resolves.	(+) Identified the lack of literature in this area, specifically randomized controlled trails. (+) Analysed multiple aspects of spinal care- Specifically the impact of spinal movement in normal range of motion on injured site. (+) No competing interests (-) Theory based evidence only (-) Nil Data (-) Nil Population (-) Greater than 5 years old

				Epidemiology and long-term treatment: Reduction of tissue hypoxia is most important basic factor in trauma management. Physics: The head, neck and body de-accelerate at different rates. The total energy applied to the spine must be minimised or absorbed by other sites than the injured site to minimise further damage.	

Comment on General Findings

- Self-extrication significantly reduces c-spine movement of patients involved in motor vehicle crashes when compared to use of mechanical devices.
- The long spinal board can have negative implications for patients
- There is a paucity of high-quality prospective, randomised controlled trials on this CAT.

Consideration for Practice

Based on the literature gathered, a change of practice is recommended. Current guidelines are not well defined. In patients that are able it is recommended that they are requested to self-extricate from the vehicle and instructed to lie down in a position of comfort on a stretcher as close to the vehicle as possible. If the patient does not meet NEXUS criteria, a collar should be applied prior to self-extrication. Incidences where mechanical extrication should be considered include:

- Any significant distracting injuries
- Impaired awareness – ALOC, intoxication
- Immediate onset of spinal/midline back pain
- Focal neurological deficit
- Priapism
- History of past spinal surgeries or conditions that predispose instability of the spine
- Unable to actively rotate neck 45° to the left and right.

However, a formulaic approach to every trauma patient must be avoided. The least complex and most familiar form of extrication that focuses on reducing c-spine movement and shortening scene to definitive care time should be adopted. Regarding the patient detailed in the clinical scenario, it is recommended that this patient is requested to self-extricate.

Conclusion

There is a paucity of high-quality prospective, randomised controlled trials on this CAT. Such trials are logistically and methodologically challenging in the pre-hospital setting. All patients that can do so should be instructed to self-extricate with a cervical collar applied from the vehicle as this has shown to reduce c-spine movement. A change to clinical practice guidelines is needed to more clearly define extrication procedures and techniques.

References

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