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BRIEF REPORT

Comparison of a SAM Splint-Molded Cervical Collar with a Philadelphia Cervical Collar

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Objective.—To compare the effectiveness of a SAM splint molded into a cervical collar with that of a Philadelphia cervical collar at limiting movement of the cervical spine in 5 different movements.

Methods.—This study was prospectively carried out in 13 healthy volunteer subjects. A hand-held goniometer was then used to measure degrees of maximal extension (starting in a maximally flexed position), rotation (left and right), and lateral flexion (left and right) with each collar. The results were then analyzed for the 5 independent movements using the paired *t* test to determine the effectiveness of the SAM splint compared with that of the Philadelphia collar.

Results.—There was no statistically significant difference between the Philadelphia collar and the SAM splint at limiting movement of the cervical spine in any of the measured movements or in total allowed degrees of movement.

Conclusion.—The results of this study suggest that the SAM splint, when molded into a cervical collar, is as effective as the Philadelphia collar at limiting movement of the cervical spine.

Key words: cervical vertebrae, trauma, spinal cord injuries, spinal injuries

Introduction

Medical emergencies in the wilderness setting include a vast array of both injury and illness.[1,2] Because of the catastrophic outcome possible with a cervical spine injury, it is generally accepted that the cervical spine should be immobilized for extrication of trauma patients in both the urban and the wilderness setting.[3] In fact, Levitan presented a case of multiple occult cervical fractures in a patient who fell while climbing Grand Teton in Wyoming with minimal symptoms.[4] The NEXUS study[5] and the Canadian C-Spine rules[6] suggest criteria to help determine which patients in the emergency department should have cervical spine imaging performed and which patients can have their cervical spine cleared clinically. In the wilderness setting, these criteria are often used to determine whether or not to immobilize the cervical spine while transporting the victim. With longer extrication times for the multiple trauma/injury victim, the question of spinal immobilization becomes more complicated, because resources in the wilderness environment are limited.

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The SAM splint (SAM Medical Products Co, Newport, OR) is an aluminum and foam moldable splint used for a variety of extremity and skeletal injuries. This splint is common in both first aid and wilderness medical kits. The package insert and user's guide demonstrate the use of a SAM splint molded into a cervical collar for spinal immobilization (Figure).[7] No studies have been published demonstrating the effectiveness of this practice compared with accepted cervical immobilization devices. The purpose of this study was to compare the effectiveness of a SAM splint molded into a cervical collar with that of the Philadelphia collar (Ossur Orthopedics, Reykjavik, Iceland) at limiting movement of the cervical spine.

Methods

This study prospectively compared the molded SAM splint cervical collar with the Philadelphia collar in 13 healthy volunteer subjects with no history of cervical spine injury. Subjects were recruited from the Drexel University College of Medicine emergency medicine residency program and signed a written consent form prior to study enrollment. A power analysis was per-

Figure. SAM splint-molded cervical collar (reproduced with permission from SAM Medical Products Co.).

formed before initiation of the study, assuming an alpha of 0.05 and a beta of 0.80, with the goal to detect at least an 11° difference between the collars to determine the study population size. The subjects had both the SAM splint–molded cervical collar applied (in accordance with the manufacturer's manual)[7] and the Philadelphia collar applied while sitting upright in a chair. A small, medium, or large Philadelphia collar was used dependent on the subject's neck size. A hand-held goniometer was then used to measure degrees of maximal extension (flexion and extension were combined into extension from a maximally flexed position to eliminate the possibility of changes in the starting/neutral position), rotation (left and right), and lateral flexion (left and right) with each collar according to accepted practices of measuring the cervical spine. A tongue blade was held between the patient's molars and used as the starting and stopping point for extension with the goniometer centered over the angle of the mandible. Rotation was measured from overhead with one arm of the goniometer in line with the acromion and the other arm in line with the nose. The arm in line with the nose was moved from 90° with the nose, and the difference from 90° at maximal rotation was recorded. Lateral flexion was measured with the center of the goniometer over the spinous process of C-7, one arm parallel to the floor, and the other, moveable arm over the occipital protuberance. The degrees of movement of the occipital protuberance, from midline at maximal lateral flexion, were then recorded. This is the method advocated in *Krusen's Handbook of Physical Medicine and Rehabilitation.*[8] Each of the movements was measured 3 times per subject, and the mean was calculated. All measurements were taken with the subjects sitting in an upright position, because this study was only comparing cervical collar effectiveness and not full spinal immobilization. The same investigator applied all collars and did all the measurements to limit variations in technique. The results were then compared, for each measured variable and the total allowed degrees of movement, using the paired *t* test to determine the effectiveness of the SAM splint compared with that of the Philadelphia collar and any significant differences. This study was approved by the Institutional Review Board at Drexel University College of Medicine. The investigators have no financial interest in the manufacturers of either device used in this study. Both the Philadelphia collars and the SAM splints were donated from the Drexel University College of Medicine's Department of Emergency Medicine.

Results

The table shows the mean degrees of movement in each measured direction and the mean total degrees of movement for each collar per subject. In addition, the mean difference between the SAM splint and Philadelphia collar ± SD and the *P* values are shown from the 2-tailed paired *t* test.

There was no statistically significant difference between the Philadelphia collar and the SAM splint at limiting movement of the cervical spine in any of the measured movements or in total allowed degrees of movement.

Table. Mean degrees of movement in each measured direction and mean total degrees of movement for each collar per subject

Degrees of movement	*Philadelphia collar (PC)*	*SAM splint (SS)*	*Mean difference of SS from PC ± SD**	P *value from paired* t *test*
Extension	17.6	20.2	2.54 ± 6.94	0.212
Rotation right	18.8	20.1	1.33 ± 3.87	0.238
Rotation left	19.3	20.6	1.25 ± 3.38	0.205
Flexion right	20.8	18.6	−2.23 ± 4.00	0.068
Flexion left	15.9	14.5	−1.46 ± 4.39	0.258
Total/subject	92.5	97.4	4.92 ± 23.6	0.466

Discussion

With limitations in space and the ability to carry an abundance of supplies into the wilderness setting, this study set out to determine if the SAM splint could adequately immobilize the cervical spine in a patient requiring cervical spine immobilization. By comparing the SAM splint with a Philadelphia collar, we found no significant difference in the ability of the 2 collars at limiting movement of the cervical spine. Podolsky and colleagues, in a prior study, found that the Philadelphia collar is as effective as numerous other collars available for cervical spine immobilization.[9] None of these devices has the broad range of uses that can be performed by a SAM splint (in addition to limiting movement of the cervical spine).[7] The ability to carry one universal device for so many different medical conditions is one of the advantages of the SAM splint. This study helps to validate the practice of using a SAM splint as a universal splint for environments with limited medical supplies.

This study has several limitations. The sample size was relatively small, with only 13 subjects, although adequately powered given the pretest power analysis. In addition, although some prior studies have used radiography to measure cervical spine movements, the risk of radiation to healthy subjects was not justified and a hand-held goniometer was used instead to measure the degrees of movement.[10,11] The methods of measuring movement were similar to prior studies and followed an accepted practice of taking these measurements without using radiography.[8,9,12] In addition, goniometric measurements have been shown to correlate well with radiographic measurements.[13] Another possible limitation is that application of a SAM splint is dependent on the method used and the operator's familiarization with the splint. Any effect this may have on the results was limited by using one person to apply all splints following the manufacturer's guidelines.[7] Although studies of cervical collars have shown the Philadelphia collar to limit cervical spine movement as well as other cervical immobilization devices, none of these devices has been shown to limit movement of the cervical spine to the maximally accepted 11° of movement, thereby necessitating full spinal precautions and not just a cervical collar for transport when possible.[9,14] This was the case in this study as well. The SAM splint did not differ significantly from the Philadelphia collar, which has been shown in the past to reduce movement significantly from no immobilization collar.[9]

Despite these limitations, the results of this study suggest that the SAM splint, when molded into a cervical collar, is as effective as the Philadelphia collar at immobilizing the cervical spine.

The possibility of future research into the use of a SAM splint in settings with limited resources is extensive. The *SAM Splint User's Guide* has numerous recommended applications, and validation of these will allow further confidence in its use as a universal splint.[7]

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