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Technology

An evidence-based mobile decision support system for subaxial cervical spine injury treatment

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Abstract

Bringing evidence to practice is a key issue in modern medicine. The key barrier to information searching is time. Clinical decision support systems (CDSS) can improve guideline adherence. Mounting evidence exists that mobile CDSS on handheld computers support physicians in delivering appropriate care to their patients. Subaxial cervical spine injuries account for almost half of spine injuries, and a majority of spinal cord injuries. A valid and reliable classification exists, including evidence-based treatment algorithms. A mobile CDSS on this topic was not yet available. We developed and tested an iPhone application based on the Subaxial Injury Classification (SLIC) and 5 evidence-based treatment algorithms for the surgical approach to subaxial cervical spine injuries. The application can be downloaded for free. Users are cordially invited to provide feedback in order to direct further development and evaluation of CDSS for traumatic lesions of the spinal column.

Key Words: Decision support, handheld, iPhone, mobile computing, subaxial cervical spine injury

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INTRODUCTION

Evidence-based medicine (EBM) has been described as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. It means integrating expert opinion and patient preference with the best available external clinical evidence from systematic research."[18] Mobilizing knowledge to action and bringing such evidence to practice is a key issue in modern medicine. A survey in the United States demonstrated that only 55% of patients received recommended care.[12] A review of physician guideline adherence shows that volume of information and time needed to stay informed are recurrent barriers.[4,22] Clinical decision support systems (CDSS) have repeatedly been suggested as a useful tool for improving guideline adherence and mobilizing evidence-based knowledge into daily clinical practice.[1,3,9,19,20] Handheld computers

provide mobile decision support that may facilitate this process.[14,15]

Subaxial cervical spine injuries are common and even among specialists there is demonstrated wide variation in what is viewed as the most appropriate treatment for these injuries.[8] The Subaxial Injury Classification (SLIC) is a valid and reliable classification system for subaxial spine trauma consisting of 3 categories: injury morphology, disco-ligamentous complex, and neurologic status.[21] When the SLIC score is larger than 4, operative treatment is recommended, consisting of realignment, neurologic decompression (if indicated), and stabilization.[21] Evidence-based algorithms for surgical approaches have been developed based on a systematic review of the literature, expert opinion, and anticipated patient preferences.[7] The use of SLIC to classify injuries and use of the algorithms to assist in determining therapeutic approaches would likely improve evidence-based practice.

This article presents a mobile CDSS that will assist in diagnosis and evidence-based surgical treatment of subaxial cervical spine injury, based on the SLIC classification and associated algorithms for the surgical approach.

MATERIALS AND METHODS

Algorithms

The algorithms were taken from the article by Dvorak *et al*.[7] A separate description of the SLIC scale is based on the article by Vaccaro *et al*.[21]

Software development and testing

Software was developed by the first author in XCode 3.1 and the iPhone SDK (Apple Inc, Cupertino, CA). Some sample code from Mark and LaMarche was used.[10] The SLIC scale description was made using Google Docs (Google Inc, Mountain View, CA) and exported to an HTML file. Usability testing was performed by 2 neurosurgeons and an orthopedic surgeon on an iPhone 3GS running OS 3.1.2 (the application requires OS 3.0 or higher).

Further evaluation

Suggestions for improvement related to educational value and ease of use were provided by the Department of Medical Education. Additional feedback was provided by 2 orthopedic surgeons who have extensive experience with the SLIC scale.

RESULTS

The application offers a selection of 5 evidence-based algorithms [Figure 1] that can be browsed in Decision Support mode [Figure 2] or Chart mode [Figure 3]. The chart can be zoomed in and out by using multitouch gestures, a feature of the iPhone. Moreover, when rotating the device to landscape mode, it will show an overview of the SLIC scale and its references.

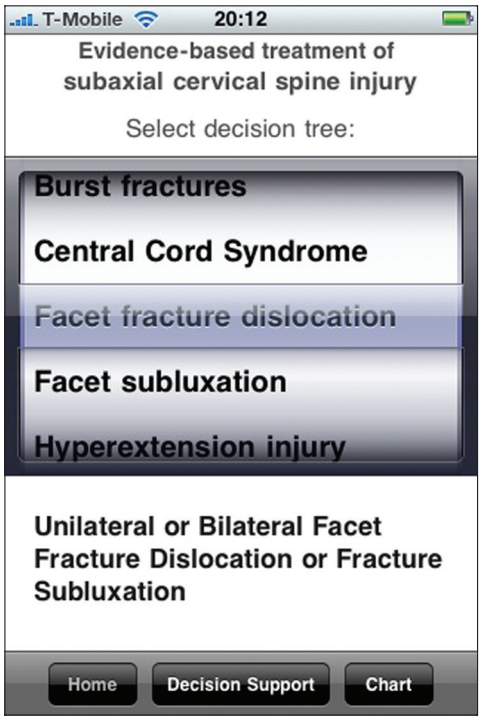

Figure 1: Overview of available treatment algorithms

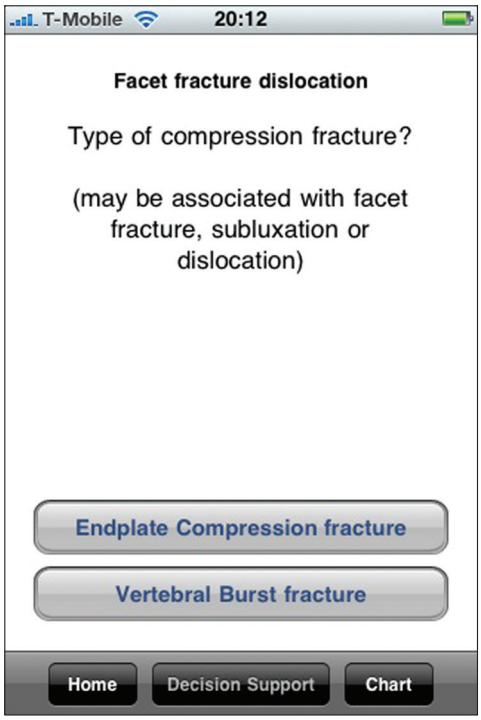

Figure 2: Browsing an algorithm in Decision Support mode

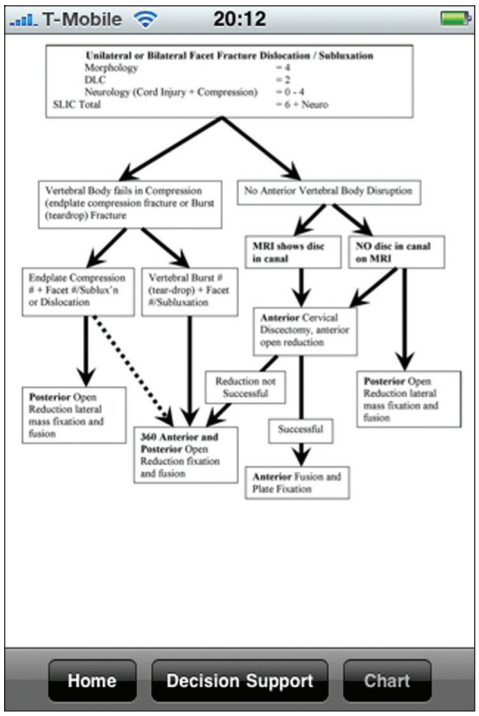

Figure 3: Browsing an algorithm in Chart mode. The chart can be zoomed in and out by finger pinching

The application has been modified according to suggestions made during usability testing, which mainly consisted of simplifying the navigation structure. No official clinical evaluation has been performed to date.

DISCUSSION

According to the PubMed Indexing Statistics, the number of journals indexed in the Index Medicus more than doubled between 1965 and 2009 and the number of citations yearly added to MEDLINE increased almost fivefold.[13] The total number of MEDLINE citations has passed 17 million now.

What is not known with certainty is the clinical impact of these articles and whether they influence clinical practice. Citation indices are neither capable of measuring quality nor clinical impact of publications.[6] There is little evidence suggesting that evidence-based reviews and case series from databases are effective in enhancing evidence uptake or changing clinician behavior.[23] Reviews on the information-seeking behavior of clinicians show that the key barrier to information searching is time.[5,22] In practice, if the search takes more than 2 minutes it will not produce information suitable for that patient consultation.[5] This time-dependent availability of information may be even more critical in the emergency setting.

Deviations from what are known to be preferred treatment guidelines for basic care may pose serious threats to public health.[12,16,20] Strategies to reduce these deviations from best practices are warranted.[12,20] Health Policy decision makers, patients, and care givers are all demanding increased quality of health care and a reduction in the number of medical errors. Evidence-based guidelines may summarize the best care available, but they do not provide explicit methods to bring proven therapies to the bedside. Information technology can assist in achieving this goal. Increased use of information technology may improve medical care and the efficacy of its delivery. CDSS have been shown to improve appropriateness of antimicrobial selection for acute respiratory tract infections.[19] They have been suggested as a tool to improve EBM adoption.[1] Unfortunately, as quality of most CDSS studies is limited, no general conclusions can be made. Handheld computers, also called Personal Digital Assistants (PDAs), have been purported to increase productivity and improve patient care in recent years.[2,11,17] A recent multicenter randomized trial demonstrated a significant increase in guideline adherence when using a mobile (handheld) CDSS in the diagnosis of pulmonary embolism.[15]

Mounting evidence suggests that physician guideline adherence can be improved by offering (mobile) CDSS. The major barrier between evidence and practice is time: information access needs to be quick and to the point. Subaxial cervical spine injury is an emergency requiring urgent diagnosis and a therapeutic plan. Evidence-based algorithms are available, and can be used as guidelines for treatment. The SLIC iPhone application offers a mobile CDSS that can facilitate diagnosis, and improve adherence to evidence-based treatment algorithms. It is available as a free download from the App Store. Users are cordially invited to provide feedback in order to direct further development and evaluation of CDSS for traumatic lesions of the spinal column.

CONCLUSION

Evidence-based practice can benefit from mobile CDSS to improve physician guideline adherence. Subaxial cervical spine injury is an emergency requiring urgent diagnosis and a therapeutic plan. A valid and reliable classification (SLIC) and corresponding evidence-based treatment algorithms are available. A mobile CDSS is presented that can facilitate the use of this classification and these treatment algorithms.

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