AJNR

CT ScoutView for skull fracture: substitute for skull films?

L D Cromwell, L A Mack and J W Loop

AJNR Am J Neuroradiol 1982, 3 (4) 421-423
http://www.ajnr.org/content/3/4/421.citation

CT ScoutView for Skull Fracture: Substitute for Skull Films?

Laurence D. Cromwell[1]
Laurence A. Mack
John W. Loop

The efficacy of the posteroanterior and lateral ScoutView images with an abbreviated (every other cut) computed tomographic (CT) examination for skull fractures and associated intracranial trauma was analyzed. The every-other-slice CT study found all the brain injuries detected by the complete CT study. In addition, 20 of 21 skull fractures were identified on the posteroanterior and lateral ScoutView studies. This modified CT examination can be performed for about the same cost as standard skull radiography and represents a much better investment of the patient's resources than the traditional skull series and complete CT study.

Current interest in radiologic efficacy began with a study by Bell and Loop [1] in 1971. Their original report listed high-yield criteria that successfully identified 93 of 94 patients with skull fractures of 1,500 patients seen for cranial trauma. They suggested that films in the absence of high-yield criteria seldom had clinical usefulness. Despite this and other reports [2] confirming the limited clinical usefulness of skull radiography in the trauma setting, the community standard in most areas includes a skull series of almost all patients seen with head trauma, regardless of clinical findings.

Since the original article by Bell and Loop [1], Phillips [3] refined the list of high-yield criteria by expanding the total number of patients in the series and increasing the statistical significance of the data. Phillips [4] further stated that the occasional negative skull series can create a false sense of security, and he noted cases of malpractice jeopardy where a negative skull series constituted a liability rather than an asset. Despite intense interest in skull film efficacy at a sister institution, skull radiography has continued unabated at Harborview Medical Center, where nearly 2,500 skull radiographs are obtained each year, even with the development of the GE 8800 computed tomographic (CT) scanner 2 years ago. Numerous reasons have been advanced to explain this admitted overuse. Cummins [5] concluded that it resulted from a complex combination of factors, such as: mentor and peer group pressure; patient and family demands; malpractice threats; time management concerns; and established personal routines. Together, these have defeated educational efforts to modify physician behavior.

Familiarity with the Harborview emergency room suggests that clinical management sometimes depends heavily on radiographic findings. Such dependency should be based on examinations that are clinically meaningful. In the instance of head trauma, skull films do not qualify. As DeSmet et al. [6] pointed out, the recognition of skull fractures should not be the end point. The more important objective is evaluation of injuries to the brain.

The GE 8800 and other scanners have a software package called ScoutView that was developed initially as an aid for determining the angle of various CT sections. Early on we became impressed with the diagnostic capabilities of the ScoutView and wondered if it could be substituted for skull radiography. We

Received December 9, 1981; accepted after revision February 16, 1982.

L. D. Cromwell is an affiliate of the Child Development and Mental Retardation Center.

[1] All authors: Department of Radiology, University of Washington School of Medicine, Seattle, WA 98195. Address reprint requests to L. D. Cromwell.

AJNR 3:421–423, July/August 1982
0195–6108/82/0304–0421 $00.00

A B C

Fig. 1.—**A** and **B**, ScoutView films were false-negative. Important information was on axial image (**C**), which showed intraparenchymal hematoma.

conceived of a modified CT examination in the trauma setting consisting of every other slice through the head (unless an abnormality were present in which case every slice would be scanned), supplemented by posteroanterior (PA) and lateral ScoutView studies. Although this approach was expected to detect skull fractures, it was not considered the end point of our diagnostic workup. Rather, we sought an effective method to identify patients at risk for intracranial hemorrhage and other brain injury. The possibility of lesser cost was also a consideration. Before adopting this as routine, a pilot project was carried out.

Materials and Methods

Of 82 consecutive head trauma patients who had a cranial CT examination, 29 were rejected from the study because they had no skull films and 53 were selected for the final analysis. Films of the complete CT examination and of an abbreviated study consisting of every other slice were evaluated independently. PA and lateral ScoutView images were included with both examinations. All scans were obtained on a GE 8800 scanner at 614 mAs and 9.6 sec scan time. The complete CT examination generally encompassed 12 slices, each 10 mm thick. The modified CT examination consisted of either the odd numbered or the even numbered 10 mm slices of the complete study. Evaluation of fractures on the PA and lateral ScoutView films was performed prospectively on line at the physician display console. Comparison of the complete and the every-other-cut modified scans was done retrospectively from hard copy film by a single observer (L. D. C.). The skull films were considered the "gold standard" for comparison with the ScoutView images. We depended on written reports from various other observers for the presence of fractures on the skull series.

Results

In the trauma setting there was no difference in our ability to detect intracranial pathology using the modified every-other-cut CT study versus the complete examination. When an abnormality was detected on the every-other-slice study, the reader appropriately identified it and stated that, per the protocol, the complete examination would have been appropriate. It should be noted that most of the trauma resulted from high-speed motor vehicle accidents and was rather severe. Of the CT scans, 19 were considered normal, while 10 patients had subdural hematomas, eight had intraparenchymal hematomas, three had subarachnoid hemorrhage, and two had epidural hematomas. Seven patients were demonstrated to have air-fluid levels in various sinuses; another four had intracranial gas, two had depressed skull fractures, and two suffered from gunshot wounds. Two CT scans were thought to be compatible with "contusion." The number of radiologic findings on the CT scans is more than the number of patients, because six of the patients had two or more significant abnormalities.

Of the 53 patients in the study, 21 had fractures demonstrable on skull radiography. The rest had normal skull films. The PA and lateral Scoutview studies identified 20 of 21 fractures. Sensitivity (the ability of the examination to detect disease) was 95% and the specificity (the ability to exclude patients without disease) was 100%. In the one patient in whom the ScoutView did not demonstrate the skull fracture, it was faintly visible on the right lateral skull film and not on the left lateral projection. This fracture was not seen on the ScoutView, not only because the ScoutView was a left lateral, but also because the resolution of ScoutView is not optimal. Interestingly enough, in this case, the intraparenchymal hematoma was on the side opposite the skull fracture and represented a coup-contrecoup injury (fig. 1).

Discussion

Early in the study, we rediscovered basic radiographic principles that pertain to CT scanning just as much as to traditional radiography. These include careful positioning; the virtues of the PA versus anteroposterior (AP) ScoutView (less geometric distortion of facial structures and less dose to the lens); and the necessity of avoiding artifacts. In several instances, the PA and lateral ScoutView studies were superior in quality to the traditional skull series. Because of the reluctance of our emergency room physicians to sedate a traumatized, combative, or noncooperative patient, it is usually easier for us to perform a reasonably good CT examination than it is to get a good quality skull radiograph. Although the CT exposure is 9 sec, it is easier to restrain the patient. In addition, slight degrees of canting or angulation about the axial plane are not as detracting on CT as on traditional skull films.

Some of the complex facial fractures were more easily identified on the axial CT images than on the traditional skull films, and we found CT to be especially good at demonstrating air-fluid levels and depressed skull fractures. Since CT

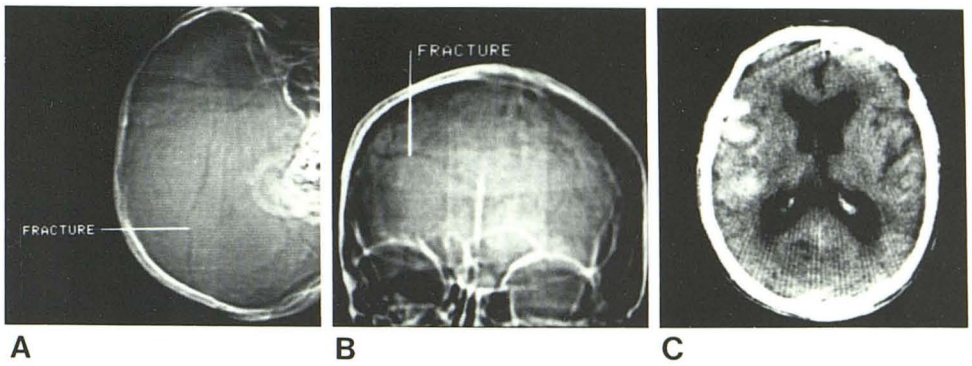

Fig. 2.—**A** and **B**, Positive ScoutView studies. Annotated software package was used to delineate skull fracture. More important information was on axial image (**C**), which showed severely contused and hemorrhagic brain.

is so much more sensitive to density discrimination, it is much easier to identify small collections of intracranial gas on CT than on skull radiography. However, while CT is good at demonstrating fractures at right angles to the plane of scanning when the fractures are oriented such that the discontinuity is parallel to the cut, they are much more difficult to recognize than with traditional imaging.

The well coned ScoutView did not show the incidental findings that are occasionally present on skull radiography, such as fractures of the superior cervical spine. However, good quality lateral ScoutView images can be obtained of the cervical spine at the same sitting, much as some institutions include a lateral view of the cervical spine with a skull series.

In addition to the one patient in whom a skull fracture was not identified on the ScoutView, there was one patient who had several skull fractures on skull radiography, of which only one was seen on the Scoutview. We noted that an occipital fracture is not well displayed on a Caldwell ScoutView projection. Further, it is difficult to obtain a Towne projection on the CT scanner, even with gantry angulation.

A new software update allows us to annotate either the ScoutView image or the axial projection and is very useful for timely communication of radiographic findings (fig. 2).

In summary, we believe that modified or every-other-cut CT with PA and lateral ScoutView studies, which can be performed for about the same price as a skull series, represents a much better investment of the patient's money and provides more information on which to base clinical care. However, it must be emphasized that a negative CT examination does not exclude pathology, such as the instance of an isodense balanced bilateral subdural hematoma. We caution that certain limitations of this technique must be recognized. Our advocacy of the every-other-cut CT with PA and lateral ScoutView studies is based on a limited experience from one institution. We do not know if this recommendation is applicable to other populations and other scanners.

It is possible that our study has already affected the much overused standard skull radiographic examination. Preliminary data (Phillips LA, personal communication) show that in the last several months only about 100 routine skull examinations were being performed per month for trauma at Harborview Medical Center, and the number of cranial CT studies for trauma increased by about 30 per month. This is in comparison with the last 9 months of 1980, when 2,460 skull examinations and only 100 cranial examinations were performed for trauma. We are unsure whether this change represents the effects of efficacy monitoring or the acceptance of our modified CT examination with the PA and lateral ScoutView studies. Nevertheless, we are hopeful it will continue.

REFERENCES

1. Bell RF, Loop JW. The utility and futility of radiographic skull examinations for trauma. *N Engl J Med* **1974**;284:236–239
2. Masters FJ. Evaluation of head trauma: efficacy of skull films. *AJR* **1980**;135:539–547
3. Phillips LA. Emergency services utilization of skull radiography. *Neurosurgery* **1979**;4:580–582
4. Phillips LA. Skull radiography and professional liability. *West J Med* **1979**;131:82–83
5. Cummins RO. Clinicians' reasons for overuse of skull radiographs. *AJR* **1980**;135:549–552
6. DeSmet AA, Fryback DG, Thornbury JR. A second look at the utility of radiographic skull examination for trauma. *AJR* **1979**;132:95–97