Skull X-ray after head injury: the recommendations of the Royal College of Surgeons Working Party Report in practice

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SUMMARY

In 1986 a Royal College of Surgeons Working Party published guidelines, based on over 15 years of clinical research both here and in the U.S.A., on when to perform skull X-rays on a head injury patient. In this retrospective study the recorded details of 405 patients who presented to an accident and emergency (A&E) department over a 3-month period in 1991 are analysed, and the Report criteria applied to each one to assess whether the guidelines are being followed in performing a skull X-ray. According to these guidelines, 191 of these patients (47.2%) should have been X-rayed, however, only 83 were. Only one patient was thought to have been X-rayed inappropriately. The Report criteria most commonly thought by the A&E doctors not to warrant skull X-ray, were loss of consciousness, amnesia, dizziness, blurred vision, headache, and alcohol intoxication.

The reasons why these criteria are being ignored are examined, and together with reference to recent studies, slight alterations to the Working Party guidelines are suggested to make them more applicable to everyday clinical situations of head injury encountered in a casualty department.

INTRODUCTION

Head injury accounts for 10% of new attendances at A&E departments in the U.K. Although on the whole these are minor head injuries, in 1981 head injury caused 1% of all deaths in the U.K., rising to 15% of all deaths in the 15–24 year age group (Jennett & MacMillan, 1981).

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Skull X-ray is performed in a head injury patient to decide whether or not to admit someone who is otherwise seemingly well enough to go home. X-ray may do this by detecting a skull fracture and occasionally by detecting midline shift of a calcified pineal gland. The X-ray may also help in the management of a patient who will be admitted whatever the X-ray shows, in that it may show the extent of a depressed fracture or show the presence of a foreign body or intracranial air.

In recent years, the use of skull X-rays in the assessment of head injury has been scrutinized in various studies (Bell & Loop, 1971; Masters, 1980; RCR Working Party, 1981, 1983a; Fowkes *et al.*, 1984; Masters *et al.*, 1987; Feuerman *et al.*, 1988; De Lacey *et al.*, 1990; Miller *et al.*, 1990; Teasdale *et al.*, 1990), some even arguing against the need to X-ray at all (Feuerman *et al.*, 1988; Masters, 1980; although these studies have been carried out in the U.S.A. where wider use of CT scanning is employed). However, the absolute risk of developing intracranial haematoma in the fully orientated head injury patient increases from 1:6000 to 1:32 if a skull fracture is present (Mendelow *et al.*, 1983). Current practice is to use skull X-ray to identify the latter group for hospital admission. In order to aid A&E doctors in deciding whom to X-ray, guidelines were published in 1986 in the Report by the Working Party for the Royal College of Surgeons. The aim of this report was to reduce the cost of performing unnecessary skull X-rays, without reducing the degree of detection of skull fractures that may lead to the development of intracranial haematoma.

The guidelines suggest that skull X-rays should be performed after a head injury when certain easily definable criteria are present (Appendix 1). Application of similar criteria in previous studies, has shown good results in reducing the number of unnecessary skull films without reducing the detection rate of intracranial haematoma (RCR Working Party, 1983a; Fowkes *et al.*, 1984; Clarke & Adams, 1987; De Lacey *et al.*, 1990).

It is all very well, having criteria for use as guidelines written down on paper, but how well can these criteria be applied to a clinical situation?

The aims of the study, were first, to identify the prevalence of these criteria in a typical population of head injury patients presenting to a London A&E department, and second, to assess whether A&E doctors performed skull X-rays, according to the guidelines in the Report.

Having assessed the interpretation and application of these guidelines in clinical practice, and considering more recent studies, we suggest slight modifications to the criteria for deciding to X-ray the head injury patient.

METHOD

Data was collected from Guy's Hospital A&E Department, staffed by one consultant, two registrars and seven senior house officers. In this retrospective study, the records of 405 patients with head injury were traced using the A&E log book between May and July 1991. The last 3 months of a 6-month period were chosen, as this involved A&E doctors with optimal experience. All entries of 'head injury', 'laceration to head', 'assault', 'fall' and 'RTA' were analysed and the non-head injury cases excluded. Children under the age of 14 were excluded, since children are more likely to

develop intracranial haematoma without skull fracture (Teasdale *et al.*, 1990), and the benefits of skull X-ray are less well defined.

By analysing the recorded history and examination findings, it was possible to see which criteria, if any, were met, and whether the patient had received skull X-rays or not. The number of patients meeting each of the Report's six criteria for skull X-ray, was recorded in Table 1. Symptoms such as dizziness, visual disturbance and headache were considered only if present at the time of examination. The group of patients who fulfilled the criteria for skull X-ray, and yet did not receive one, was further analysed, and the relative incidences of the Report criteria 'ignored' in this group were recorded in Table 3.

Table 1. Incidence of criteria for skull X-ray after recent head injury

Criterion	No.	%
(1) Loss of consciousness or amnesia at any time	99	24.4
(2) Neurological symptoms or signs	62	15.3
(3) CSF or blood from the nose or ear	7	4.0
(4) Penetrating injury or scalp bruising or swelling	73	18.0
(5) Alcohol intoxication	64	15.8
(6) Difficulty in assessing the patient	15	3.7

Total number of patients = 405

RESULTS

A total of 14 sets of records were untraceable. All records found displayed a high quality of note-keeping, this was probably a result of the monthly audit of note-keeping that takes place in the department.

A total of 405 patients presented to the A&E department with head injury over a 3-month period. Of these patients, 83 (20.5%) received skull X-rays, of which nine patients (2.2%) had a skull fracture. Five of the patients not receiving X-rays on their first visit, subsequently re-attended with symptoms and were X-rayed at a later date. The return attendances were excluded from the study.

Loss of consciousness or amnesia at any time were reported by 99 patients (24.4%), making it the largest single indication for skull X-rays. The incidences of the other criteria can be seen in Table 1.

Applying the criteria to the study group, we see that 82 of the 83 patients X-rayed met one or more of the criteria (Table 2). The one X-ray that was thought not to meet any of the criteria was for an uncomplicated scalp laceration. The Report states, 'Note: simple scalp laceration is not a criterion for skull X-ray' (RCS Working Party, 1986). A total of 109 patients met one or more of the criteria for skull X-rays and yet did not receive one. Eleven of these were admitted anyway, leaving 98 who were sent home without X-ray. The relative incidences of criteria ignored are shown in Table 3.

Table 2. Application of criteria to study group to assess eligibility for skull X-ray

Category	No.	%
(1) Criteria met and X-ray performed	82	20.2
(2) No criteria met but X-ray performed	1	0.2
(3) Criteria met but no X-ray performed	109	26.9
(4) No criteria met and no X-ray performed	213	52.6

Total number of patients = 405

Table 3. Relative incidences of criteria 'ignored' by A&E doctors when deciding not to perform skull X-ray (breakdown of category 3 in Table 2)

Criterion	No.	%
(1) Loss of consciousness or amnesia at any time	47	43.1
(2) Neurological symptoms or signs	23	21.1
(3) CSF or blood from the nose or ear	1	0.9
(4) Penetrating injury or scalp bruising or swelling	19	17.4
(5) Alcohol intoxication	18	16.5
(6) Difficulty in assessing the patient	12	11.0

Total number of patients = 109; 11 patients met more than one criterion.

Thus only 82 of the 191 patients meeting the Report criteria for skull X-ray actually received one, or 98 of the 405 patients seen (24.2%) were sent home without an X-ray, even though they fulfilled the criteria for X-ray.

DISCUSSION

The results in Table 2 show that of the 191 patients eligible for skull X-ray by satisfying the Report criteria, only 82 (42.9%) actually received one. This is surprising, since in previous studies the suggestion has always been that following similar guidelines would *reduce* the number of skull X-rays (RCR Working Party, 1983a; Fowkes *et al.*, 1984; Clarke & Adams, 1987; De Lacey *et al.*, 1990). It would be easy to attribute all this to selection errors made by A&E doctors, however, only one X-ray was performed inappropriately, and the pick-up rate of nine skull fractures from a head injury population of 405 (2.2%) compares well with figures quoted in the 1986 RCS Working Party Report (also 2.2%). From this study, in which the criteria was applied to 405 clinical situations of head injury, the authors were able to isolate problems in clinical application of the guidelines.

In the group of 109 patients who were not X-rayed, yet had positive criteria (i.e. those on Table 3), 47 exhibited 'loss of consciousness or amnesia at any time'. This was the most commonly ignored criterion. Interestingly, in 38 of these cases

there was amnesia, or known loss of consciousness for less than 5–10 min, and the examining doctor felt that the presence of these criteria *alone* did not warrant an X-ray. Some studies have suggested that in these cases there is no significant increase in the risk of development of intracranial haematoma (Bell & Loop, 1971; Masters, 1980). However, in practice it is often difficult to tell exactly how long a patient has been unconscious, and whether or not the amnesic patient has been unconscious at all. Therefore, it is agreed with the Report in that, as a rule, this category of patients should be X-rayed.

The second group in Table 3 shows that 23 patients were not X-rayed despite the presence of neurological symptoms or signs. This sounds disturbing, however, 19 of the patients in this group of patients had either slight headache, dizziness or blurred vision only at the time of examination. These symptoms have not been associated with any increased risk of developing intracranial haematoma (Bell & Loop, 1971; Masters, 1980; RCR Working Party, 1983b; Freed, 1986; Masters *et al.*, 1987), are very non-specific, and we believe, when present alone, should be excluded as criteria for X-ray. How many patients attending an A&E department with head injury would admit to having slight headache if asked directly?

Scalp bruising or swelling was present in 19 patients who were not X-rayed. The extent of these findings, and the degree of tenderness present will obviously dictate the clinician's decision to X-ray. It has been demonstrated that the small proportion of scalp wounds penetrating the galea have a significantly higher risk of yielding an underlying fracture (Ballantyne *et al.*, 1985). Not mentioned in this group is periorbital haematoma, the presence of which has been shown to increase the likelihood of fractures and intracranial sequelae significantly (Masters, 1980; Freed, 1986). This could be included as an indication for X-ray.

Alcohol intoxication was present in 18 of those not X-rayed. Alcohol intoxication was defined as abnormal behaviour which may be attributable to alcohol, and not simply a history of consuming alcohol. This group should also include those with drug intoxication, although there were no drug intoxicated patients in this study. Eleven of these patients were admitted anyway, without an X-ray, and were discharged after a period of observation. Where alcohol intoxication is present, the patient should be admitted for observation, and the benefit in performing a skull X-ray to decide on the need for admission, no longer exists. Inadequate quality films are also obtained frequently. The patient can be reviewed later when no longer intoxicated, and the necessity for skull X-ray or further detainment reassessed. In some circumstances, however, an X-ray may help if fracture is suspected, since closer observations or even CT scan can be made if a fracture is present.

Of the 12 patients not receiving a skull X-ray in the 'difficulty in assessing' group 5 were post-ictal epileptics who received a head injury after a seizure, and four were elderly ladies with confusion and dementia. One cannot always tell if a seizure and post-ictal drowsiness in an epileptic, or vagueness in an elderly patient, came before or after the head injury itself. Any seizure associated with a head injury is associated with a higher risk of intracranial consequences (Masters, 1980), although head injuries occurring after a seizure in a known epileptic have resulted in less intracranial sequelae than usual, perhaps due to chronic epileptics having thicker skulls (Russell-Jones & Shorvon, 1989). Head injury in those over 65 years has been shown to have a much higher mortality (Galbraith, 1987; Klauber, 1989).

It is suggested that in view of difficulties in eliciting precise sequences of events from the patients, a history of seizure of any kind be included as a criterion along with loss of consciousness or amnesia, and that the elderly be X-rayed regardless of any other criteria.

The following changes are suggested to the Working Party Report guidelines for performing skull X-ray in the **adult head injury patient being sent home**:

- (1) history of loss of consciousness, amnesia or seizure;
- (2) neurological signs or symptoms other than mild headache, dizziness or blurred vision;
- (3) CSF or blood from the nose or ear;
- (4) penetrating injury or scalp or periorbital bruising or swelling;
- (5) the elderly; and
- (6) if any of the above cannot reliably be excluded.

REFERENCES

- Ballantyne E., Mendelow A. D., MacMillan R. & Brookes M. (1985) Relationships between scalp wounds and skull fractures. *IRCS Medical Science* **14**, 63–64.
- Bell R. S. & Loop J. W. (1971) The utility and futility of radiographic skull examination for trauma. *New England Journal of Medicine* **284**, 236–239.
- Clarke J. A., Adams J. E. (1987) Skull radiographs after head injury (letter). *Lancet* **ii**, 457.
- De Lacey G., McCabe M., Constant O. *et al.* (1990) Testing a policy for skull radiography (and admission) following mild head injury. *British Journal of Radiology* **63**, 14–18.
- Feuerman T., Wackym P. A. & Gade G. F. (1988) Value of skull radiography, head computed tomographic scanning, and admission for observation in cases of minor head injury. *Neurosurgery* **22**(3), 449–453.
- Fowkes F. G. R., Evans R. C., Williams L. A. *et al.* (1984) Implementation of guidelines for the use of skull radiographs in patients with head injuries. *Lancet* **ii**, 795–7.
- Freed H. A. (1986) Post-traumatic skull films: who needs them? *Annals of Emergency Medicine* **15**, 233–235.
- Galbraith S. (1987) Head injuries in the elderly. *British Medical Journal* **294**, 325.
- Jennett B. & MacMillan R. (1981) Epidemiology of head injury. *British Medical Journal* **282**, 101–104.
- Klauber M. R., Marshall L. F., Luerssen T. G. *et al.* (1989) Determinants of head injury mortality: importance of the low risk patient. *Neurosurgery* **24**, 31–36.
- Masters S. J. (1980) Evaluation of head trauma: efficacy of skull films. *American Journal of Radiology* **135**, 539–547.
- Masters S. J., McClean M. S., Arcarese M. S. *et al.* (1987) Skull X-ray examinations after head trauma. *New England Journal of Medicine* **316**, 84–91.
- Mendelow A. D., Teasdale G., Jennett B. *et al.* (1983) Risks of intracranial haematoma in head injured adults. *British Medical Journal* **287**, 1173–1176.
- Miller J. D., Murray L. S. & Teasdale G. M. (1990) Development of a traumatic intracranial haematoma after a 'minor' head injury. *Neurosurgery* **27**(5), 669–673.
- Royal College of Radiologists Working Party (1981) Costs and benefits of skull radiography for head injury. *Lancet* **i**, 791–795.
- Royal College of Radiologists Working Party (1983a) Patient selection for skull radiography in uncomplicated head injury. *Lancet* **i**, 115–119.
- Royal College of Radiologists Working Party (1983b) Skull X-ray guidelines (letter). *Lancet* **i**, 1164.
- Royal College of Surgeons Working Party — Commission on the Provision of Surgical Services (1986) *Report of the Working Party on Head Injuries*. Royal College of Surgeons, London.
- Russell-Jones D. L. & Shorvon S. D. (1989) The frequency and consequences of head injury in epileptic seizures. *Journal of Neurology, Neurosurgery and Psychiatry* **52**, 659–662.
- Teasdale G. M., Murray G., Anderson A. *et al.* (1990) Risks of acute traumatic haematoma in children and adults: implications for managing head injuries. *British Medical Journal* **300**, 363–367.

APPENDIX 1

Guidelines for management of patients with recent head injury

Criteria for skull X-ray after recent head injury

Skull X-ray can be helpful but clinical judgement is necessary and the following criteria will be refined by further experience. The presence of one or more of the following indicates a need for skull X-ray in patients with recent head injury:

- (1) Loss of consciousness or amnesia at any time
- (2) Neurological symptoms or signs
- (3) Cerebrospinal fluid or blood from the nose or ear
- (4) Suspected penetrating injury or scalp bruising or swelling
- (5) Alcohol intoxication
- (6) Difficulty in assessing the patient (e.g. the young, epilepsy).

Note: Simple scalp laceration is not a criterion for skull X-ray.