

# A New Computed Tomography-based Frontal Contusion Score for Patients with Traumatic Brain Injury

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## **Learning Objectives**

This study 1) examined how to better characterize frontal contusion in a series of traumatic brain injury (TBI) patients, and 2) developed and validated a new frontal contusion score (FCS) based on the shape of the frontal contusion to facilitate rapid, accurate assessment of the computed tomography (CT) findings of frontal contusion.

#### Introduction

Frontal contusions are characterized by gradually progressing hematoma/edema and rapid deterioration owing to central herniation, even if the patient is conscious at the time of admission. This study 1) examined how to better characterize frontal contusion in a series of traumatic brain injury (TBI) patients, and 2) developed and validated a new frontal contusion score (FCS) based on the shape of the frontal contusion to facilitate rapid, accurate assessment of the computed tomography (CT) findings of frontal contusion.

#### **Methods**

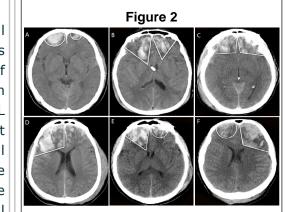
This study retrospectively analyzed data from 206 consecutive patients with isolated frontal contusions. The new score is based mainly on the shape of the frontal brain contusion(Table 1, Figure 1 and Figure 2). Forward stepwise logistic regression was used to identify independent predictors of acute neurological deterioration and refractory intracranial hypertension. A receiver-operating characteristic (ROC) curve was then drawn based on the FCS.

#### **Results**

The incidence of acute neurological deterioration increased significantly as the FCS increased. FCS, obliteration of the basal cistern, and a serum sodium decrease of more than 10 mmol/L within 24 hours were independent predictors of acute neurological deterioration. Each one-unit increase in FCS led to a 57% increase in the odds of acute neurological deterioration [odds ratio (OR), 1.57; 95% confidence interval (CI), 1.25–1.95]. The area under the curve (AUC) of the FCS that predicted acute neurological deterioration was 0.727 (95% CI 0.656-0.797). The incidence of refractory intracranial hypertension increased significantly with an increase in the FCS. Only FCS and obliteration of the basal cistern remained predictors of refractory intracranial hypertension. Each oneunit increase in FCS led to a 49% increase in the odds of refractory intracranial hypertension (OR, 1.49; 95% CI, 1.06-2.10). The area under the curve (AUC) of the FCS for predicting refractory intracranial hypertension was 0.647 (95% CI 0.532-0.763). The FCS was not an independent predictor of the 6-month mortality (OR, 0.87; 95% CI, 0.59-1.28) or 6-month unfavorable outcome (OR, 1.32; 95% CI, 0.93 - 1.87).

#### **Conclusions**

Therefore, the FCS is a valid evaluator of the character of frontal contusion. The clinical utility and generalizability of this score need to be validated in a large sample.



Representative head CT scan for frontal

contusion score (FCS). In the figure A, bifrontal contusions both showed a semicircular shape (2 score), thus the total score was 4 score. In the figure B, bifrontal contusions both shaped like an acute triangle (3 score), thus the total score was 6 score. In the figure C, bifrontal contusions both shaped like an obtuse triangle (4 score), thus the total score was 8 score. In the figure D, the left frontal brain contusion showed a scattered lesions (1 score) and the right frontal brain contusion shaped like an obtuse triangle (4 score), the total score was 5 score. In the figure E, the left frontal brain contusion showed a semicircular shape (2 score) and the right frontal brain contusion shaped like an acute triangle (3 score), the total score was also 5 score. In the figure F, the left frontal brain contusion shaped like an obtuse triangle (4 score) and the right frontal brain contusion showed a semicircular shape (2 score), the total

score was 6 score.

# TABLE 1. The diagnostic categories of this new score and their definitions. Score Definition on of frontal contusion scattered areas of frontal contusion frontal contusion forms a semicircular shape, and the bottom of

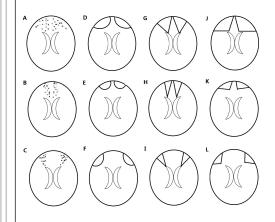
the semicircle is close to the frontal bone
the frontal brain contusion is shaped like an acute triangle, and
the bottom of the triangle is close to the frontal bone, pointed
toward the lateral ventricle
the frontal brain contusion is shaped like an obtuse triangle, and

toward the lateral ventricle

The score for a bilateral frontal contusion is equal to the sum of the contusion scores on both sides

the bottom of the triangle is close to the frontal bone, pointed

## Figure 1



A sketch map for frontal contusion score (FCS). In the figure A-C, the frontal brain contusion showed a scattered lesions (1 score). In the figure D-F, the frontal brain contusion showed a semicircular shape (2 score). In the figure G-I, the frontal brain contusion shaped like an acute triangle (3 score). In the figure J-L, the frontal brain contusion shaped like an obtuse triangle (4 score).