To the Editor: Scalp avulsion is a severe type of scalp injury, which is most often caused when long, braided hair is caught in running wheels.\(^1\)\(^2\) However, scalp avulsion combined with an open skull avulsion fracture is extremely rare. Here we report a unique case of scalp avulsion combined with open craniocerebral injury.

A 19-year-old female was transferred to our emergency department. Twelve hours prior to admission, the patient’s hair was caught in a machine that was rotating at a high speed, resulting in a severe scalp avulsion.

Glasgow Coma Scale score was 9 points. This bilateral, peeled avulsion included over 90% of the frontal, temporal, parietal and occipital scalp, and the scalp was avulsed into two flaps. There was a comminuted fracture of the right frontotemporal skull. The fractured bony fragments protruded outward and were deformed, the dura was torn, and blood clots and necrotic brain tissue were leaking from the rupture [Figure 1].

A computed tomography scan demonstrated a cerebral contusion in the right frontotemporal lobe, an intracerebral hematoma, and a comminuted fracture of the right frontotemporal skull [Figure 1]. Neurosurgeons and plastic surgeons jointly performed emergency surgery. Debridement and hemostasis were performed. Because such a large area of the scalp was avulsed and was accompanied by severe crush injuries, vascular anastomosis could not be performed due to the poor vascular condition. Therefore, a reverse-drum skin collection and replantation, combined with an in situ flap suture, was done.

The skin graft on the right frontal, temporal, parietal, and occipital scalp had also survived well. The flap in situ suture of the left frontotemporal was necrosis. After the surgery, the patient suffered from intracranial infection. On postoperative day 16, central respiratory and heart failure occurred and the patient died of severely intracranial infection.

In the present case, the patient was a female with long thick hair. During the course of work, her hair was caught in a machine that was rotating at a high speed. The resulted large amount of traction led to a large area of scalp avulsion. The injury also involved right frontal bone, dura, and brain tissue. Scalp avulsion combined with open craniocerebral injury was even much rarer than scalp avulsion alone. Hence, we believe that the mechanism and characters of this fracture are worthy to be carefully discussed.

Skull fractures are generally categorized into linear fracture, depressed fracture, comminuted fracture, and growing skull fracture in children.\(^3\) We could conclude that these striped-eggshell-like fractures were directly caused by the tremendous traction force through hair. We could name this unique skull fracture as “skull avulsion fracture.” We speculate that the mechanism of this injury was due to the following reasons: (1) The patient had long thick hair, which resulted in strong traction; (2) when the hair was pulled into the machine that was rotating at a high speed, the magnitude, direction and range of the force were rather great and complex; (3) the periosteum at the frontal bone is tightly connected to the skull and at the moment of injury, the strong traction avulsed the frontal bone, and lacerated the adherent dura and brain eventually. Although such case is extremely rare, this type of injury mechanism responsible for this type of injury needs to be explored and whether this type of fracture will be considered to be a new type of skull fracture should be determined.

After taking into consideration the many risk factors for postoperative intracranial infection, a series of active measures were applied to prevent infection, including prophylactic use of antibiotics, relevant examination of cerebrospinal fluid, and timely anti-infection therapy after intracranial infection was confirmed.

In cases of scalp avulsion combined with open craniocerebral injury, scalp survival is closely associated with wound coverage and alleviation of the risk of intracranial infection.\(^4\)\(^5\) Therefore, in the present case, scalp reconstruction was performed immediately after the skull repair, in order to improve wound healing and coverage [Figure 1]. Unfortunately, the left flap in situ began to show bruising, followed by darkening and necrosis on the 2nd day after surgery. We speculate that the scalp necrosis may have been related to the severity of scalp avulsion.
To the best of our knowledge, there are few reports of scalp avulsion combined with open craniocerebral avulsion injury in literature. Moreover, the category and mechanism of skull fracture in our case were rather unique and complex. The concept of “avulsion fracture,” which used to be confined to the field of orthopedics, may become a new category of skull fracture. As for the treatment, we realize that scalp reconstruction and wound coverage are of great importance to this type of patients, and we need cooperation with plastic surgeons in the future to explore some methods for effective scalp reconstruction and improving scalp survival.

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Conflicts of interest
There are no conflicts of interest.

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Figure 1: Preoperative picture showing complete avulsion of bilateral frontal, temporal and parietal scalp, and detachment of the right frontal, temporal, and parietal flap (panel a and b). The white arrow showed that the right frontal bone suffered an avulsion fracture due to the traction from the scalp. Three-dimensional reconstructions of the skull (panel c and d), suggesting avulsion fracture of the right frontal bone.

of scalp damage, contamination, periosteal defect, and operative method, and the unsuccessful wound covering was one of the most important reasons for causing the fatal intracranial infection.