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S Matsumoto, K Hasuo, A Mizushima, F Mihara, M Fukui, T Shirouzu and K Masuda

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Intracranial Penetrating Injuries via the Optic Canal

Shunichi Matsumoto, Kanehiro Hasuo, Akira Mizushima, Futoshi Mihara, Masashi Fukui, Toru Shirouzu, and Kouji Masuda

Summary: Two cases of intracranial penetration of a plastic or wooden chopstick via the optic canal are described. CT scans showed the chopsticks as linear hypodense structures in the suprasellar cistern contiguous with the optic canal. In one case, MR imaging was performed, which clearly depicted the foreign body and adjacent brain structures. Although they are extremely rare, transorbital intracranial penetrating injuries via the optic canal require physicians' awareness.

Transorbital intracranial penetrating injuries usually are caused by foreign bodies entering through the orbital roof or the superior orbital fissure (1, 2). Entry via the optic canal is considered extremely rare, and we have found no report in the English-language literature of this occurrence. Over the past 12 years, we have encountered two cases of intracranial penetrating injury caused by a chopstick entering the optic canal. The radiologic features of these cases are described.

Case Reports

Case 1

A 3-year-old girl fell from her chair while holding plastic chopsticks in her left hand, and one struck her left eye. The chopstick was broken and its tip was not found. Upon admittance to our hospital the next day, a linear wound about 7 mm in length was seen at the medial aspect of the left eyelid. She had completely lost vision in the left eye, which did not react to light.

A noncontrast CT study revealed a linear hypodense lesion in the suprasellar cistern (Fig 1A). The foreign body was slightly hyperdense relative to orbital fat, which seemed to be normal on the scans obtained with routine window settings. No subarachnoid hemorrhage or brain contusion was seen. Contrast-enhanced CT scans also showed a linear hypodense structure without enhancement, suggesting a foreign body. To clarify the location of the object, CT cisternography was done, which showed the relationship between the foreign body and the adjacent left internal carotid artery as well as the optic chiasm (Fig 1B). At surgery, the location of the chopstick fragment was confirmed as immediately inferior to the left optic nerve, originating from the left optic canal (Fig 1C).

Case 2

While heavily intoxicated, a 57-year-old man struck his right eye with a wooden chopstick. Upon examination at our hospital, a part of the chopstick was not found, and it was presumed that the patient had removed it by himself at the time of the event. A linear wound was noted at the medial aspect of the right eyelid. Vision and light reflex in the right eye were lost.

A noncontrast CT study showed a linear hypodense structure extending from the right optic canal to the suprasellar cistern, suggesting a foreign body, which was hypodense relative to orbital fat (Fig 2A). Minimal traumatic subarachnoid hemorrhage and intraorbital hemorrhage were evident. At MR imaging, both T1- and T2-weighted spin-echo sequences showed the foreign body as a linear signal void (Fig 2B and C). The source images and the reformatted images of MR angiography clearly depicted the foreign body lying immediately above the supraclinoid right internal carotid artery and immediately below the optic chiasm (Fig 2D and E). At surgery, the chopstick fragment was found to be located immediately inferior to the right optic nerve.

Discussion

Transorbital penetrating brain injury by a foreign body is relatively rare. The orbit, which has the shape of a horizontal pyramid on a posteromedially directed axis, tends to deflect objects toward the apex, where the superior orbital fissure or the optic canal may provide passage intracranially (3). However, of the two major routes by which foreign bodies penetrate intracranially (1, 2), the most frequent is via the orbital roof, because the superior orbital plate of the frontal bone is fragile. Such penetration often leads to frontal lobe contusion. The second most frequent site of penetration is the superior orbital fissure, by which foreign bodies occasionally reach the brain stem through the cavernous sinus, resulting in serious injury.

The optic canal is so small that penetration via this route is extremely rare; in fact, to our knowledge, no such occurrence has been reported in the English-language literature. When a foreign body penetrates through the optic canal, it passes close to the optic nerve to enter the suprasellar cistern. The location of

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From the Departments of Radiology (S.M., K.H., A.M., F.M., K.M.) and Neurosurgery (M.F.), Faculty of Medicine, Kyushu University, and the Department of Neurosurgery, Saiseikai Fukuoka General Hospital (T.S.), Fukuoka, Japan.
Address reprint requests to Shunichi Matsumoto, MD, Department of Radiology, Saiseikai Fukuoka General Hospital, Tenjin 1–3–46, Chuo-ku, Fukuoka 810, Japan.

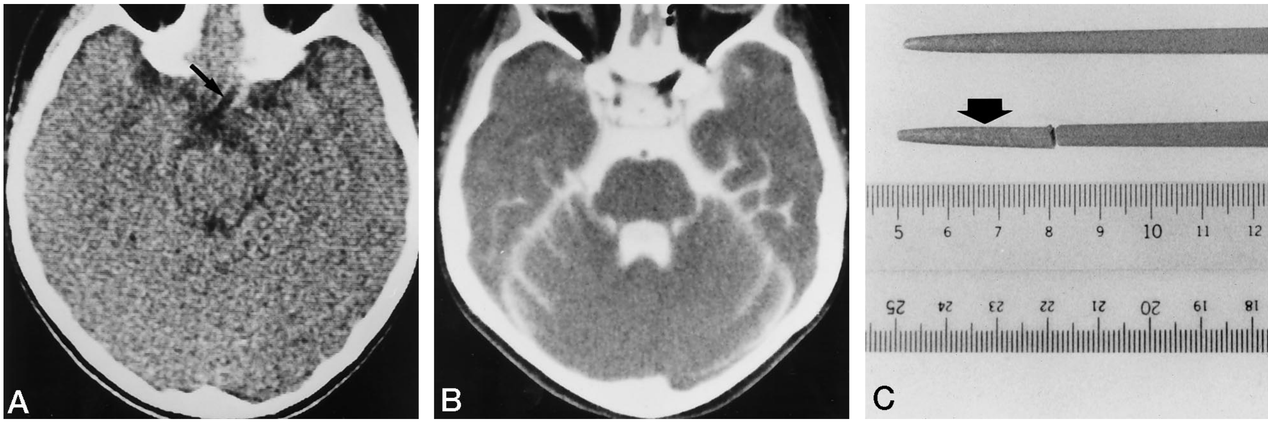

FIG 1. A 3-year-old girl in whom a fragment of chopstick penetrated via the left optic canal.

A, Noncontrast CT scan shows a linear low-attenuation structure (*arrow*) in the suprasellar cistern. High density along the margin of the foreign body suggests minimal hemorrhage. No enhancement was evident on a postcontrast CT scan (not shown).

B, CT cisternogram clearly shows a low-attenuation foreign body extending from the left optic canal to the suprasellar cistern. The foreign body passes through the left optic canal and lies anterosuperior to the left internal carotid artery, beneath the optic chiasm.

C, A fragment of the plastic chopstick, about 3 cm in length (*arrow*), was removed surgically.

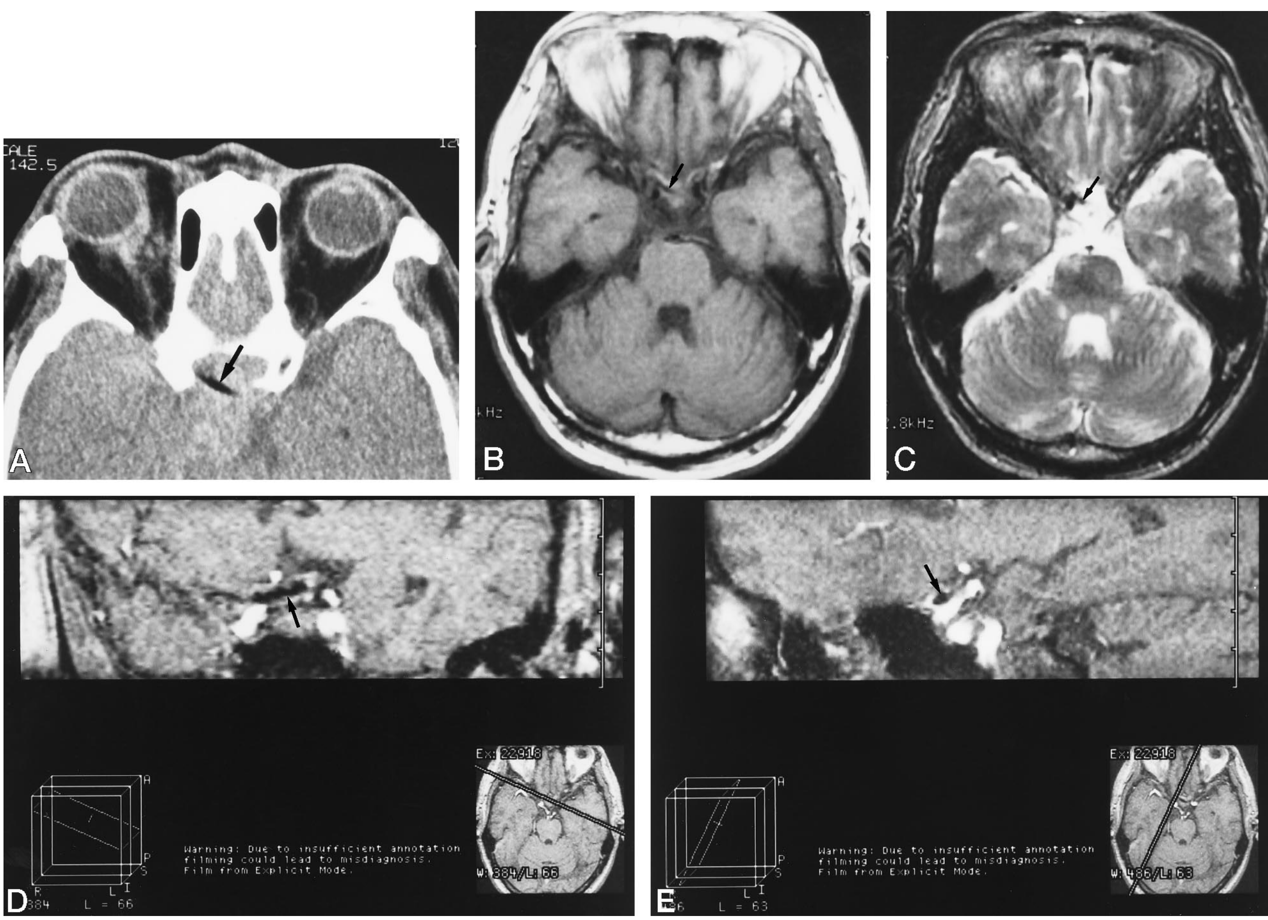

FIG 2. A 57-year-old man in whom a fragment of chopstick penetrated via the right optic canal.

A, Noncontrast CT scan shows a linear low-attenuation structure (*arrow*) extending from the right optic canal to the suprasellar cistern; intraorbital hemorrhage also is seen at the posteromedial aspect of the right globe.

B, Axial spin-echo T1-weighted MR image (500/18/1 [TR/TE/excitations]) shows a hypointense linear structure (*arrow*) with minimal subarachnoid hemorrhage in the suprasellar cistern.

C, Fast spin-echo T2-weighted MR image (2500/100/1; echo train of 8) also shows the foreign body as a hypointense structure (*arrow*).

D and *E*, Three-dimensional spoiled gradient-echo MR images (31/4.8/1; flip angle of 20°) with oblique coronal reformatting parallel to the foreign body (*D*) and oblique sagittal reformatting perpendicular to the foreign body (*E*) show the foreign body as a linear signal void (*arrows*) lying just anterosuperior to the supraclinoid right internal carotid artery. The wooden chopstick fragment, about 2 cm in length, was removed surgically.

the foreign body, therefore, is important in establishing the diagnosis. As the optic nerve is located just superior to the internal carotid artery, it is important to determine the relationship between it and the foreign body before surgery.

When penetrating orbital or cranial injury is suspected, CT is considered the primary diagnostic examination (3, 4). While CT easily detects metallic objects, wooden foreign bodies may be problematic in radiologic diagnosis (3, 5, 6). Intracranial wood may show varying degrees of attenuation on CT scans. Dry wood, which often displays low attenuation, resembling air bubbles, should not be dismissed as air or an artifact. In subacute and chronic stages, a wooden foreign body absorbs water and approaches tissue density (3).

Angiography is required to identify injury to intracranial vascular structures (3). Contrast-enhanced CT with thin sections also may help to depict the relationship between the foreign body and vascular structures, such as the internal carotid artery. In our case 2, involving a wooden object, we performed MR imaging, including MR angiography. On the MR images, intracranial dry wood was noted as a signal void and the relationship between the foreign body and the adjacent internal carotid artery was clearly depicted. Green et al (7) reported a case of intraorbital wood shown as a signal void on MR images, as in our case. Thus, MR imaging may be useful in delineating foreign bodies and their relationship to adjacent structures. However, MR imaging is possible only when the foreign body does not include a magnetic metal (8). Although both CT and MR imaging may be available for the detection of nonmetallic foreign bodies, such as wood and plastic, CT at various window widths should be considered the primary diagnostic technique, because MR imaging may not differentiate dry wood from air or bone fragments (9).

Conclusion

The optic canal rarely becomes the route of transorbital penetrating brain injury. CT is the initial diagnostic method of choice, although a hypodense foreign body must not be mistaken for air or artifact. When the foreign body is nonmetallic, MR imaging may be added to further characterize the object, any associated lesions, and the relationship between the foreign body and adjacent structures.

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