Successful repair of an intracranial nail-gun injury involving the parietal region and the superior sagittal sinus

Case report

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Intracranial nail injuries to the brain are rare. Various techniques for the removal of penetrating nails have been reported, but to date successful nail extraction following an injury involving the superior sagittal sinus (SSS) has not been reported.

The authors report the case of a nail-gun injury to the midline parietal region with penetration of the SSS. They describe an original surgical technique involving the use of a graft patch of temporal fascia and muscle to repair the SSS following extraction of the nail. The procedure resulted in preservation of distal flow across the sinus and a good neurological outcome. Technical considerations in the repair of penetrating posterior SSS injuries are discussed.

Penetrating nail injuries to the brain involving the SSS can be successfully repaired with maintenance of sinus patency.

KEY WORDS • nail • intracranial • superior sagittal sinus • repair

In this article we describe a patient who sustained a nail-gun injury to the midline parietal skull that traversed the SSS. We used an original technique of nail extraction and repair of the sinus with flow preservation, resulting in a good neurological outcome.

Case Report

History and Examination. This previously healthy 37-year-old man presented to our care complaining of severe headache after sustaining a penetrating nail-gun injury to his skull. There was no loss of consciousness. The patient’s physical evaluation showed the nail head flush with the skull in the midline parietal region. The neurological evaluation was significant for moderate difficulty in word finding; otherwise the findings were normal. Computerized tomography and CT angiography revealed that the 3-in nail had entered the midline parietal region, traversed the SSS, and entered the left parietal lobe parenchyma; there was associated edema and an enlarging hematoma (Fig. 1 left and center). After initiation of antibiotic therapy, the patient was transferred to the operating room for immediate nail removal and repair of the SSS.

Operation. A left parietal horseshoe scalp flap was made to expose the midline. Next, a left parietal craniotomy was performed while leaving an island of bone around the nail to keep it stabilized. At this time, a separate left temporal incision was made and a graft of temporal fascia and muscle was removed and saved.

The dura mater in the left parietal region was opened and, on brain depression, the nail was noted to have pierced the outer and the left inner membrane of the sinus and entered the brain. Depression of the midline parietal cortex near the sinus hole in the sagittal sinus caused brisk bleeding from the sinus. The nail was identified and, with some manipulation, the hematoma along its track was removed. We recognized that removing the nail would create significant bleeding from the undersurface of the parietal sinus. Because of the abundance of bleeding, a simple tamponade of this large hole was not possible and risked uncontrolled bleeding. A method was devised to keep the temporal graft tightly compressed against the sinus. A 4-0 Neurolon suture was tied to the exposed intracranial region of the nail at one end and to the temporal muscle graft at the other end (Fig. 2). The nail was slowly removed under direct vision, pulling the suture through the sinus and the temporal graft along with it. This resulted in bleeding, which was quickly controlled by pulling the suture through the skull hole and securing the temporal graft against the sinus. Bone wax was used to occlude the hole in the skull and the outer surface of the sinus. A burr hole cover was placed over the hole in the skull that had been made by the nail, and the suture was tied to it by

Abbreviations used in this paper: CT = computerized tomography; SSS = superior sagittal sinus.
using traction to keep the temporal graft firmly drawn up against the hole in the inner surface of the sinus. Hemostasis was confirmed, the bone flap was replaced, and the wound was closed.

**Postoperative Course.** Postoperative CT angiography demonstrated a patent SSS. The patient’s headaches improved and he was discharged on postoperative Day 3. At the 6-month follow-up examination we found complete resolution of the man’s word-finding difficulties. A CT angiogram (Fig. 1 right) obtained at that time demonstrated patency of the SSS.

**Discussion**

Reports of penetrating nail injuries to the brain originated in Nigeria, where criminals were punished by driving long nails into their heads.\(^5^\text{-}^7\) Today, the most common cause is accidental and usually work related, although some cases of suicide\(^8\text{-}^1^1\) or punishment have been reported. Most patients with intracranial nail injuries survive with a relatively good neurological outcome, as long as the great cerebral vessels are left intact and the brainstem is spared. The most commonly reported complications are the development of meningitis and cerebral abscesses. Therefore, initiation of antibiotic therapy is generally advocated.

In the reported literature on nail-gun injury to the skull, the site of entry of single nail injuries to the brain is usually close to the midline, but serious hemorrhage at the time of injury is rare. Our review of the literature revealed two earlier cases in which a nail had penetrated the frontal SSS without significant hemorrhage, similar to the experience in the present case. In both of these reported cases, howev-

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**Fig. 1.** *Left:* Nonenhanced CT scan of the brain revealing the 3-in nail entering into the midline parietal region, traversing the SSS, and entering the left parietal lobe parenchyma. Associated hematoma and edema are visible. *Center:* A CT angiogram of the brain with three-dimensional reconstruction demonstrating the nail traversing the SSS and entering the left parietal lobe. *Right:* A CT angiogram obtained at the 6-month follow-up examination. The SSS remains patent. Arrows indicate the SSS. Arrowheads indicate the straight sinus.

**Fig. 2.** Artist’s drawings of the repair of the parietal sinus made with a graft of temporal muscle and fascia. *Left:* A suture is passed through the graft and tied to the nail before extraction. The nail is subsequently removed, pulling the muscle and fascial graft against the sinus. *Right:* The suture is secured to the outer table of the skull by using a burr hole cover.
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...er, the patient suffered significant hemorrhage during nail extraction. It is likely that the pointed tip of the nail created small entry and exit holes through the outer and left inner walls of the sinus, which were subsequently firmly impacted by the thicker flange of the nail.

Sacrificing the SSS posterior to the coronal suture generally causes neurological sequelae. Although primary repair is possible, it is technically demanding and time consuming, and also requires a prolonged period of flow stasis. The technique we describe in this report has the advantage of providing an immediate repair, preserving the anatomical walls of the SSS, and providing hemostasis by a tamponade mechanism against the outer and inner walls of the SSS while allowing for continuity of flow through the lumen of the sinus.

Conclusions

Penetrating nail injuries to the brain involving the SSS can be successfully repaired with maintenance of sinus patency. The method of sinus repair we describe in this article may be useful in cases of through-and-through posterior sinus injury.

References


