

# **Management of penetrating craniocerebral injuries from nail-gun use**

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# Introduction

- Numerous reports of nail-gun injuries and fatalities.<sup>1</sup>
- Penetrating craniocerebral nail-gun injuries have also been reported.<sup>2</sup>
- Careful clinical assessment and imaging followed by removal of the foreign body with vascular control.

<sup>1</sup>Thomas MD, Siu K. An unusual cranial injury caused by an industrial nail-gun. *Med J Aust.* 1987; 147(11-12): 602-3.

<sup>2</sup>Jithoo R, Govender ST, Nathoo N. Penetrating nail gun injury of the head and chest with incidental pericallosal artery aneurysm. *S Afr Med J.* 2001; 91(4): 316-7.

# Introduction

- Patients survived with good neurological outcome provided if brain stem and major vessels are spared.
- Meningitis and cerebral abscess risk. Antibiotics are strongly advocated.<sup>3</sup>
- Risk of secondary missile formation as a result of skull bone fragment.<sup>2</sup>
- Other complications include intracranial haemorrhage and false aneurysm formation.<sup>2</sup>

<sup>2</sup>Jithoo R, Govender ST, Nathoo N. Penetrating nail gun injury of the head and chest with incidental pericallosal artery aneurysm. S Afr Med J. 2001; 91(4): 316-7.

<sup>3</sup>Sani S, Jobe KW, Byrne RW. Successful repair of an intracranial nail-gun injury involving the parietal region and the superior sagittal sinus. Case report. J Neurosurg. 2005; 103(3): 567-9.

# Introduction

- A foreign body that has completely penetrated into the brain needs to be removed via craniotomy.
- Extraction of a foreign body with both intracranial and extracranial extensions remains contentious.
- Several different techniques have been used to remove a foreign body under direct vision.<sup>4,5</sup>
- Spennato *et. al.*, (2005) described a technique known as double concentric craniotomy (one around the point of penetration and then a larger bone flap around the smaller one).<sup>4</sup>
- This enables removal of nail under direct vision without transmitting undue force to internal structures. If there was any bleeding, then this could be controlled.<sup>4</sup>
- However, craniotomy has its associated risks.

<sup>4</sup>Spennato P, Bocchetti A, Mirone G, Savarase L, Squillante D, Rotondo M, Natale M. Double concentric craniotomy for a craniocerebral penetrating nail. Case report and technical note. *Surg Neurol* 2005; 64(4): 368-71.

<sup>5</sup>Tancioni F, Gaetani P, Pugliese R, Rodriguez Y, Baena R. Intracranial nail. A case report. *J Neurosurg Sci.* 1994; 38(4): 239-43.

# Introduction

- The blind removal of foreign bodies with endovascular support has also been reported.<sup>6</sup>
- Cunningham *et al.*, (2004) successfully removed a glass earpiece penetrating the cavernous sinus whilst the intracavernous segment of the ICA was endovascularly occluded by a balloon.<sup>6</sup>
- This technique may also be useful if the offending penetrating intracranial foreign body is located in close proximity to a blood vessel
- Risk of subarachnoid haemorrhage had the artery perforated during removal of foreign body via endovascular approach.
- There is also a significant risk of a stroke secondary to insufficient collateral flow during balloon occlusion.<sup>6</sup>

<sup>6</sup>Cunningham EJ, Albani B, Masaryk TJ, Rasmussen PA. Temporary balloon occlusion of the cavernous carotid artery for removal of an orbital and intracranial foreign body: case report. *Neurosurgery*. 2004; 55(5): 1225.

# Aim

- To evaluate the outcome of closed gentle traction in the management of penetrating craniocerebral nail-gun injuries with extracranial extension.

# Methods

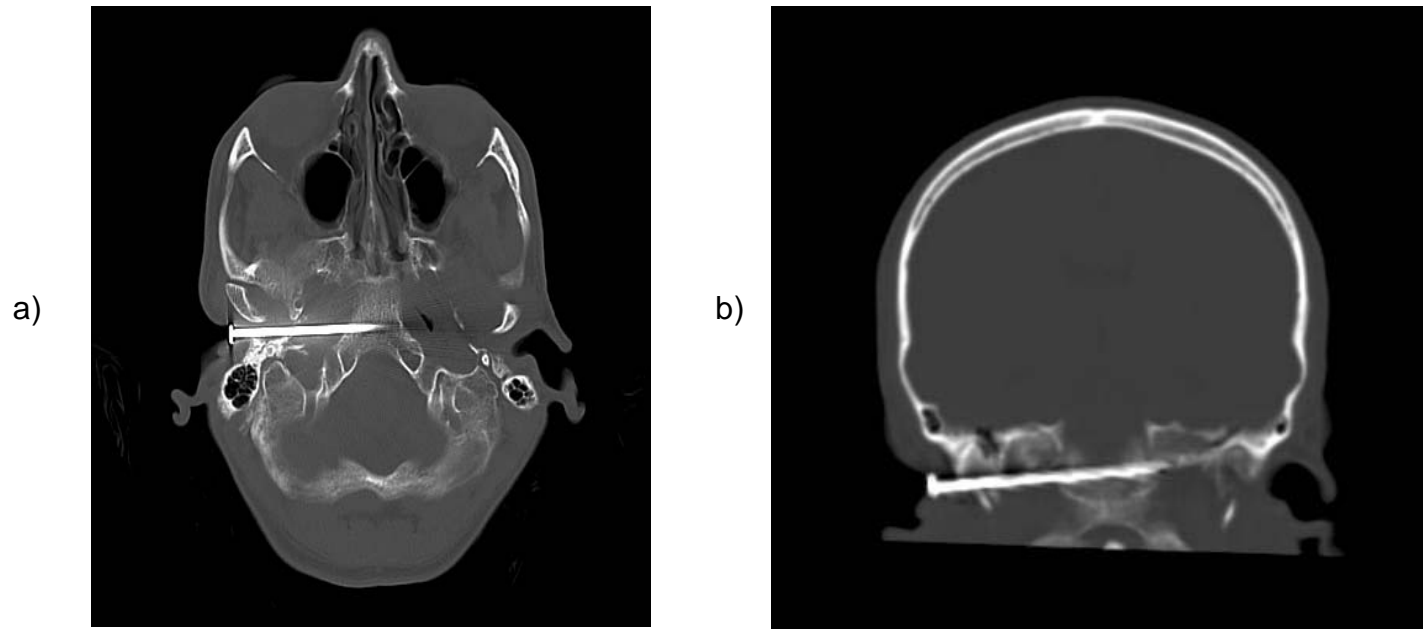
- Three cases of penetrating craniocerebral nail-gun injuries with extracranial extension were selected.
- Angiography were performed to rule out vascular involvement.
- Preparations for craniotomy and/or endovascular intervention were made in case of any haemorrhagic or ischaemic sequelae.
- Post-operative CT scan to check for post-operative bleeding.

# Case 1

- 37-year-old male was admitted with nail-gun injury to the head.
- Patient was fully conscious with equal and reactive pupils and no focal neurological signs. A 65 mm nail could be seen protruding out anterior to the tragus of the right ear.
- Computed tomography (CT) of the head revealed intracranial penetration (Fig. 1).



# Case 1



**Fig. 1** Axial (a) (b) and coronal (c) CT scans of the brain at hospital admission. The nail is seen entering the right petrous temporal bone, transversing the clivus to enter the left petrous temporal bone. There was no intracranial haemorrhage.

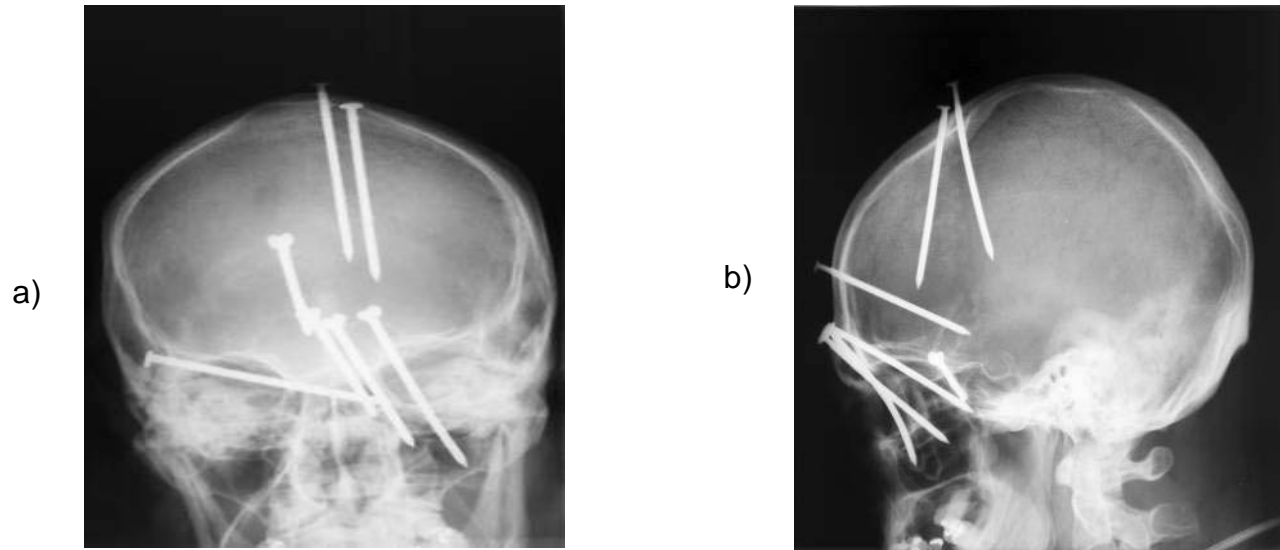
# Case 1

- The nail was removed successfully via closed gentle traction under general anaesthetic.
- Post-operatively patient 1 had an uneventful recovery and remained fully conscious with no neurological deficits.
- A post-operative CT scan revealed no signs of intracranial haemorrhage.

# Case 2

- Patient 2 was a 52 year old gentleman with a known history of psychotic depression.
- Presented with seven self-inflicted nail-gun injuries to the head. He was fully conscious with stable vital signs. There were no focal neurological deficits apart from visual defects. Visual acuity testing revealed perception of light in the right eye and hand movement in the left eye.
- Skull X-ray confirmed the presence of seven 90 mm intracranial nails in the frontal area (Fig. 2). There were no visible fractures.

# Case 2



**Fig 2** Plain anterior-posterior (a) and lateral (b) skull X-rays demonstrating seven nails penetrating the cranium at a variety of angles involving the fronto-parietal and cribriform plate regions. There appears to be no associated bone fissuring.

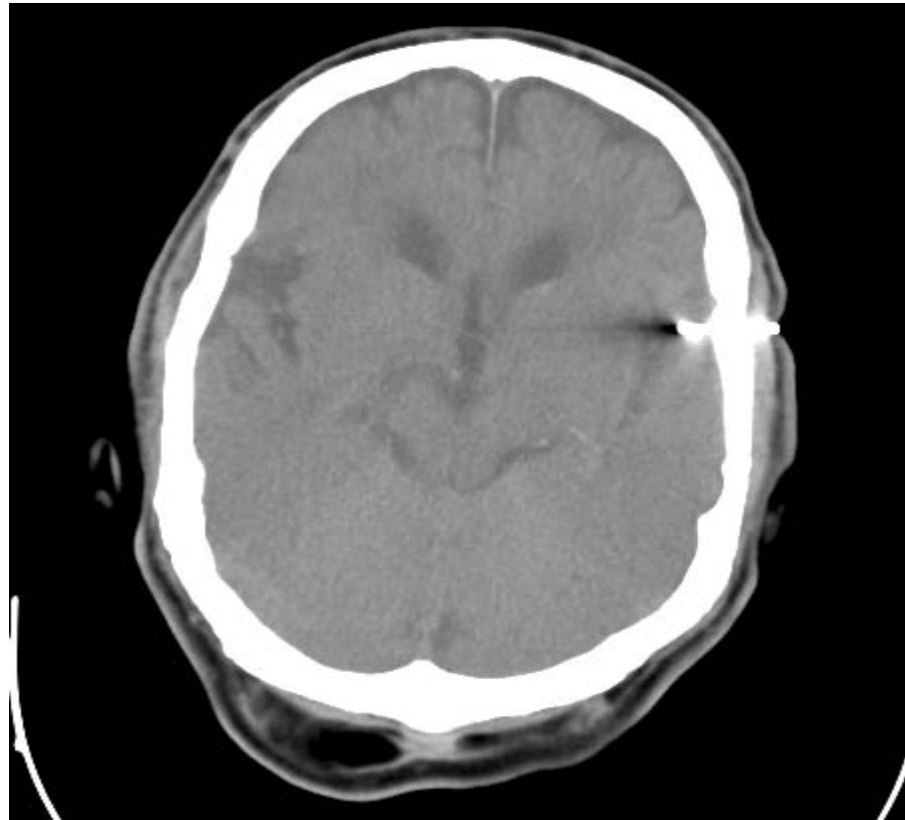
# Case 2

- CT head revealed three of the nails were present in the frontal lobe. Another three nails were present in the left orbit and one nail was in the right orbit.
- There were no signs of any intracranial haemorrhage. Angiography revealed no vascular involvement.
- The right orbital nail was removed with caution.
- A left eye vitrectomy and lensectomy was performed and the nail penetrating the left globe was removed. Endolaser therapy was performed to repair the retinal tears. The eye was then filled with silicone oil. The remaining two nails in the left orbit were removed without complication.
- The three intracranial nails were extracted by the neurosurgical team via closed gentle traction, without complication. Post-operative CT unremarkable.

# Case 3

- Patient 3 was a 69-year-old gentleman
- The 25 mm nail ricocheted off the work piece and got lodged in the head. The head of the nail was visible just above the left pterion.
- He was fully conscious, pupils equal and reactive with no neurological deficit and he had stable vital signs.
- CT head revealed the nail extending through squamous temporal bone into the left temporal lobe (Fig. 3).
- The nail was then removed via closed gentle traction. Follow-up CT scan revealed no intracranial bleeding.

# Case 3



**Fig. 3** Axial CT scan of the brain at hospital admission demonstrating a 25mm nail extending from the left squamous temporal bone into the left temporal lobe. There was no bleeding associated with the intracranial penetration.

# Result summary

- The nails were removed successfully using closed gentle traction.
- Post-operatively all three patients had an uneventful recovery and remained fully conscious with no neurological deficits.
- Post-operative CT scans revealed no signs of intracranial haemorrhage.



# Conclusions

- If angiography is negative for vascular involvement and the patient is asymptomatic, the nail should be extracted via closed gentle traction.
- Craniotomy and/or an endovascular approach should be reserved for those with symptoms of a vascular involvement and also when the nail has no extracranial extension.
- Preparations for craniotomy and/or endovascular intervention should nevertheless be made in case of any haemorrhagic or ischaemic sequelae.
- A post-operative CT scan is recommended after nail extraction to detect intracranial haemorrhage.
- Bigger studies with a larger patient sample is needed

Thank You