

# Penetrating Neck Trauma from Nail Guns

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## ABSTRACT

We report 2 unusual cases of penetrating neck trauma arising from nail guns. Nail guns are commonly used in the building industry. The nails are 8 cm long and are driven in by a small explosive charge.

The nails are a low velocity projectile and in close proximity can cause penetrating trauma similar to a low powered handgun. Both cases involve a Zone I penetrating injury to the neck.

**Keywords:** neck, trauma, nail gun

## INTRODUCTION

Penetrating neck trauma is usually due to gun shot wounds and stab wounds. We present 2 cases of unusual penetrating neck trauma arising from nail guns.

The nail gun is widely used in the building and construction industry. It uses a small explosive charge to drive in nails which measure 8 centimetres in length and weigh 9 grams. It is a low velocity single projectile. In close proximity ie. less than 30 cm it has the potential penetrating power similar to that of a small handgun. There is a safety mechanism to allow firing only when the nail tip is in contact with a surface but as demonstrated in these two cases it is not fool-proof.

The cases involve injury to Zone 1 of the neck. Zone 1 extends from sternal notch to the cricoid cartilage<sup>(1)</sup>. Penetrating trauma to this area can cause injury to the major blood vessels in the neck and upper thorax as well as the lungs, oesophagus and larynx. The thyroid gland, thoracic duct and brachial plexus are also at risk<sup>(2)</sup>.

Zone 1 injuries are associated with a higher mortality because of the injury to these vessels and structures<sup>(1-3)</sup>.

## CASE 1

Mr N is a 29-year-old construction worker who presented to the A & E Department. He was accidentally shot in the neck with a nail gun by a co-worker. On physical examination, he was fully conscious. Vital signs were stable. He was not in respiratory distress. A nail was noted to be completely embedded in the lower neck with only the nail head visible on the skin surface. The nail was pointing towards the apex of the left lung.

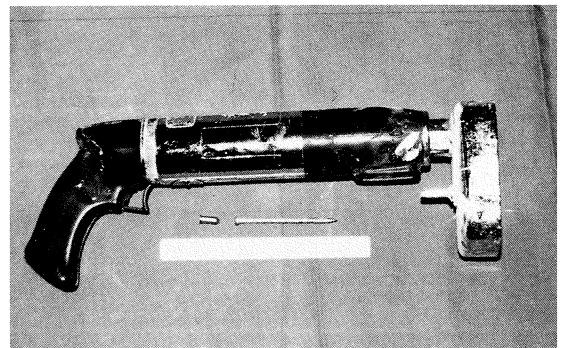


Fig 1 – Nail gun

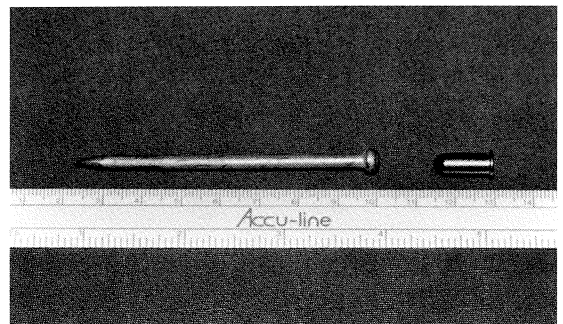


Fig 2 – Nail with cartridge

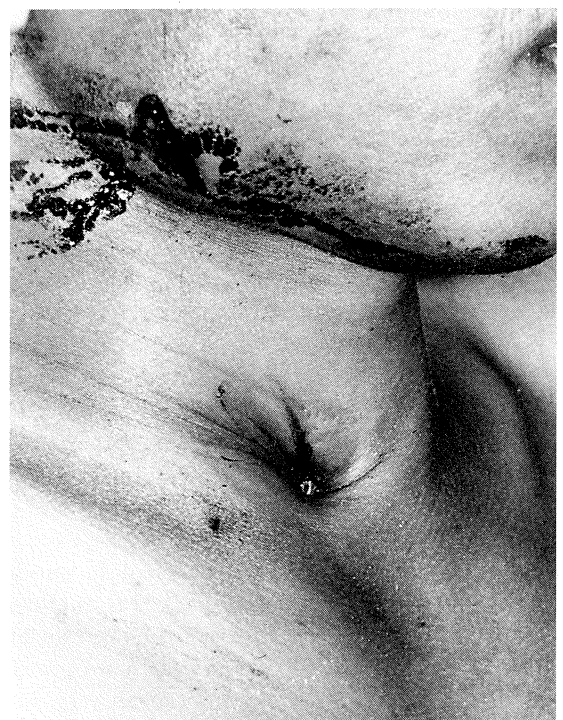


Fig 3 – Nail completely embedded with entry wound at sternal notch

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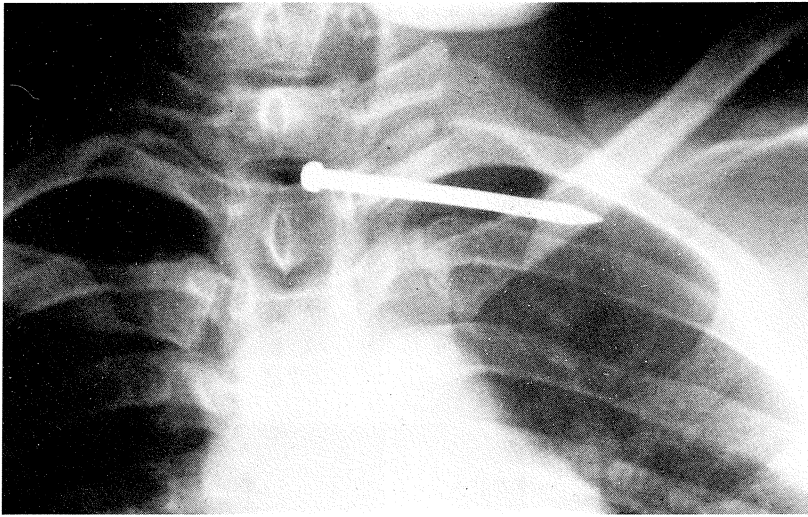


Fig 4 – Chest X-ray showing position of nail

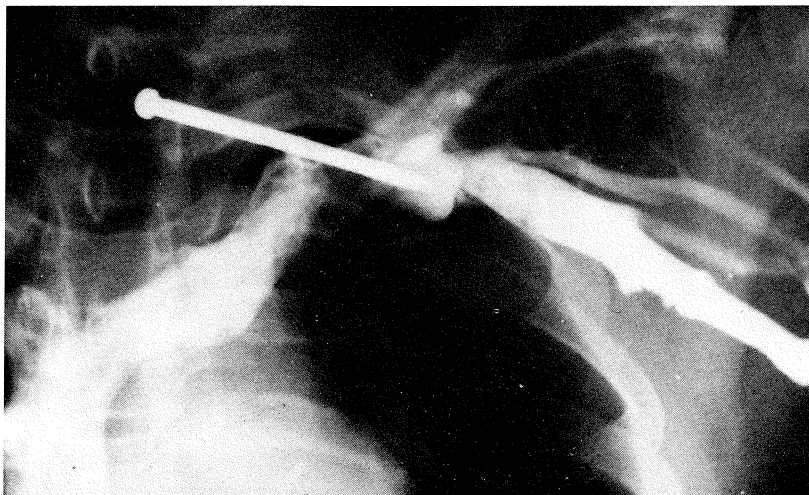


Fig 5 – Arteriogram

No surgical emphysema was noted around the neck. Radial pulses were equal. No upper limb neurological deficits were present.

Chest X-ray showed an 8 cm nail with the tip directed towards the apex of the lung. No pneumothorax or hemothorax was noted. A carotid arteriogram was ordered and this showed the left common carotid and subclavian artery to be intact.

The venous phase showed the tip of the nail to be impinging onto the middle part of the left subclavian vein. Blood flow into the left innominate vein was sluggish and was suggestive of penetration.

Bronchoscopy and oesophagoscopy were done prior to neck exploration and no obvious perforation of the aerodigestive tract was identified. The neck was explored via two incisions with isolation of the subclavian and jugular veins. At surgery the nail tip was noted to be impinging on the subclavian vein, but not penetrating into the vein. The thoracic duct was noted to be transected and was ligated. The nail was removed and the patient made an uneventful recovery.

## CASE 2

Mr Y, a 35-year-old construction worker fell from a ladder onto a nail gun. The gun accidentally fired and the nail penetrated the neck just above the sternal notch with the exit wound noted at the back of the neck.

On examination, his blood pressure and pulse were stable. He was however stridorous and had hemoptysis. Blood gases showed an oxygen saturation of 97%. The radial pulses were equal. Neurological weakness of the right arm was noted. An emergency tracheostomy followed by endoscopic assessment and neck exploration were done. Laryngoscopy showed the right vocal cord to be grossly inflamed and oedematous. A subglottic mucosal puncture wound was noted 2 mm below the vocal cords. Oesophagoscopy showed anterior and posterior oesophageal wall tears at the 17 cm level.

Neck exploration revealed a transverse laceration of the 2nd and 3rd tracheal ring with a through and through puncture of the posterior pharyngeal wall. The oesophageal lacerations were repaired in two layers. The tracheal laceration was repaired with careful approximation of the mucosa and a laryngeal stent was placed. A nasogastric tube was inserted. Orthopaedic evaluation confirmed a C<sub>8</sub>/T<sub>1</sub> Nerve root injury which was managed conservatively.

A post-operative barium swallow did not show any extravasation of dye. The laryngeal stent was removed after 3 weeks. Fiberoptic examination following removal of the stent showed both vocal cords to be mobile. A tracheal stenosis was noted to be developing around the repaired tracheal ring. The stenosis was managed successfully with the CO<sub>2</sub> laser and he was decanulated after six months. His upper limb neurological deficit recovered completely after six weeks.

## DISCUSSION

The policy of evaluating and managing penetrating head and neck trauma is still controversial. The policy on mandatory versus selective exploration is still unclear even in major trauma centres. The mode of management ranges from exploring all wounds that violate the platysma to selective exploration based on clinical, radiological and/or endoscopy findings<sup>(1-4)</sup>. The studies comparing selective exploration with routine exploration showed no clear advantage between the two<sup>(1)</sup>.

Clinical indications for mandatory exploration include active bleeding, pulse deficit, increasing subcutaneous emphysema, haematemesis, hemoptysis stridor and hoarseness. The consensus was that surgeons should base their treatment protocol according to their experience and the facilities available<sup>(5,6)</sup>.

The nail gun is an unusual cause of penetrating neck trauma. The penetrating power of the nail gun, depending on its proximity, lies somewhere between a stab wound and a low powered handgun.

There are no precedent management guidelines for these unusual cases of penetrating neck trauma. The decision was to follow management principles as for penetrating trauma from gunshot wounds. The cases were also managed along more conservative lines.

In Case 1, the direction of the embedded nail and its proximity to major vessels and structures in the neck, made us order an urgent arteriogram. Scalfani refuted recommendations that angiography is unnecessary in asymptomatic patients. Asymptomatic patients suspected to have vascular injury following penetrating neck trauma close to major neck vessels were considered candidates for angiography. 31% of asymptomatic patients we found to have sustained major vascular injury in Zone 1<sup>(3,4)</sup>.

Although no occult arterial injury was identified in Case 1, a venous injury was identified. The arteriogram also helped us plan our surgical approach for safe removal of the nail. Thoracic duct injury was also identified in this case and should be conscientiously looked for in Zone 1 injuries. If injured the thoracic duct should be ligated rather than attempting repair<sup>(2)</sup>. In Case 2, the patient had stridor and the management plan was more straight forward. An emergency tracheostomy was performed followed by endoscopy. Panendoscopy has been recommended as an alternative to mandatory exploration in patients who are stable. A combination of bronchoscopy and laryngoscopy is reported to be 100% accurate in diagnosing tracheal and laryngeal injuries<sup>(5)</sup>.

Diagnosing esophageal injuries is more difficult and even more controversial. Noyes reported that esophagograms were 90% accurate and esophagoscopy 86% accurate in his study. Even surgery was not 100% accurate at picking up

esophageal injuries. At this point in time, panendoscopy with arteriography has been found to be as good as mandatory exploration for assessment of patients with penetrating neck trauma.

Panendoscopy has the added advantage, as in this case where open exploration is required, in pinpointing the site and extent of injury especially in through and through penetrating injuries.

## CONCLUSION

The nail gun is an addition to the various projectiles involved in penetrating neck trauma. It is a low velocity projectile and can cause injuries similar to a low powered hand gun. The construction industry should be aware of this and consider having more training and safeguards for workers handling nail guns.

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