Intrathoracic Metallic Foreign Bodies

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There is an extensive literature dealing with the immediate problems, both diagnostic and therapeutic, of penetrating injuries of the thorax, but only a rather sparse amount of information on the late behaviour and appearance of intrathoracic metallic foreign bodies. In view of the large number of persons who have survived in the recent world conflict with such bodies still retained, it may be timely to review the roentgen findings in a fairly large group of cases, and to consider the detailed data concerning a small number of them.

Surgical textbooks devote very little space to the general subject of pulmonary metallic foreign bodies, or else approach it almost exclusively from the aspect of aspirated objects. For example, in Christopher's well-known book appears the statement, "Retained foreign bodies introduced from without should be removed, because otherwise they give rise to rapidly spreading infection and result in lung abscess, gangrene, empyema and suppurative mediastinitis." Since no mention is made as to whether the author is referring to aspirated or penetrated foreign bodies, the reader may reasonably assume that he means both. In Lewis' Practice of Surgery (1944) there is an extensive amount of data on aspirated foreign bodies in the thorax, but very little on the subject of penetrating objects.

DIAGNOSIS AND CLASSIFICATION

The diagnosis of intrathoracic metallic foreign bodies is usually based on the history, the presence of a scar and, sometimes, on the clinical findings. The history is occasionally misleading, since the patient may have sustained merely a glancing injury to his thorax and the fragment may be subcutaneous in location. The presence of a scar is valuable evidence, but it is to be noted that the absence of one is not exclusive; some sharp, smooth objects such as small calibre bullets may penetrate the thorax and leave virtually no visible wound of entry. If such object also leaves via the thoracic cage, the wound of exit is, of course, apt to be larger and much more readily visible. The clinical findings in the early stages are well-known; those in the late stages are apt to be

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The opinions set forth in this article are those of the writer and not to be considered as reflecting the policies of the Navy Department.
minimal, except when the patient has been the victim of complicating infection or is aware of the fact that he has a retained projectile.\(^1\)

The essential feature in the diagnosis of intrathoracic metallic foreign bodies is naturally the roentgen examination. It should consist of roentgenography in at least two planes (postero-anterior and lateral films, with fairly heavy penetration), followed by such additional projections as are indicated to confirm the location of the object or objects. Tangential “spot” films are especially useful in determining whether the missile lies within or without the lungs. Fluoroscopic examination is essential in many cases, especially with objects near the rib cage or the diaphragm. Heavy penetrated stereoscopic projections are often of value; tomograms may be necessary in some cases to determine the exact location of the fragments, especially if the patient has complicating pulmonary or pleural densities, and there is a question of juxtaposition to certain large bronchi.

Intrathoracic metallic foreign bodies may be classified in accordance with various factors such as number, size, location and so forth. Almost all of them are opaque, despite the extensive use of aluminum in aircraft and similar equipment. From the point of view of the clinician, the important facts regarding foreign bodies are, of course, the presence or absence of associated bleeding and infection, and the amount of nonmetallic material (bone splinters, clothing and other debris) driven in at the time of injury. However, from the point of view of the roentgenologist as well as that of the subsequent compiler of accurate surgical or medical records, we believe that the following data should be made available:

1. Number of opaque foreign bodies;
2. Size,
3. Shape, and
4. Position thereof.
5. Changes (not necessarily related) in adjacent structures:
   a. Pulmonary and pleural structures,
   b. Diaphragm,
   c. Thoracic wall — (soft parts and bones),
   d. Mediastinum,
   e. Heart and pericardium.
6. Movement: the movement of bodies, especially those near large cardiovascular areas should be studied fluoroscopically and recorded.
7. Other foreign bodies: adjacent areas such as the neck, shoulders and abdomen should be scrutinized, and the presence or absence of opaque bodies therein noted.
Many cases disclose multiple metallic foreign bodies; in such, only the size of the larger ones or those which are suspected as having potential clinical significance need be recorded. The shape is worth recording since jagged objects are apt to have more associated traumatic and infectious changes than smooth ones. The study of movement in connection with bodies is most important in those lying in or close to the heart and great vessels. However, fluoroscopic examination is always of value, since the existence of some metallic fragments which had been concealed by motion in the roentgenograms may thereby be revealed. Occasionally the problem of differential diagnosis between calcified nodes and metallic foreign bodies arises: in such cases also fluoroscopic examination is of value.

The nature and extent of residual pulmonary changes are often obscured by overlying pleural thickening. Fine scar tissue tracts may be visible in one film and not in another. Some metallic foreign bodies, notably slender, smooth, sharp-pointed ones, may migrate. Bullets and larger fragments will occasionally lie free in the pleural space; we have seen two cases in which considerable doubt arose as to the veracity of previous reports merely because roentgen examination had been made at one station with the patient erect and at another with him horizontal; the bullet lay at the apex one time, and at the base of the pleural cavity the second.

In connection with the classification of the exact type of foreign body present, the x-ray findings are often not characteristic. Even the personal and clinical data on these cases is difficult to evaluate. Many individuals frankly admit they do not "know what hit them"; others are quite positive that it was a sniper bullet, or a grenade or so forth; the roentgenogram may reveal a jagged piece of metal, later identified by an ordnance expert as something of quite different nature from that which the victim felt sure had hit him. In the stress of emergency medical care many wounds are labelled "gun shot wounds" and this term clings to the patient's record, despite the fact that it was produced by shrapnel, mortar, shell or grenade fragment, or by pieces of metal from nearby objects.8*

LOCALIZATION

The simplest means for the localization of the vast majority of intrathoracic metallic foreign bodies is ordinary teleroentgenographic examination in two planes (usually P. A. and lateral),

*In the African campaign (1941-43) Nicholson and Scadding encountered the following retained foreign bodies in a series of 291 cases of penetrating chest wounds: bullet 24, shell 131, mine 10, bomb (mostly mortar) 51.
supplemented by tangential or stereoscopic views as indicated. Should there be any medical or surgical indication for removal of the foreign body, the patient may be placed under the fluoroscope in the same position that he will occupy on the operating table and the exact location of the body marked on the skin in two planes, at right angles to each other. The simplest method is to use a sterile needle and place small scratch marks on the skin which will survive subsequent preoperative preparation. Other methods include the subcutaneous injection of a little dye, the insertion of sterile clips or needles and so forth.

Should associated injuries or other considerations prevent placing the patient in two different planes, various other methods of localization including stereoscopy, parallax, triangulation and so on may be resorted to. In actual practice these are rarely necessary in connection with the types of case reviewed in this paper (See Table I).

### TABLE I

<table>
<thead>
<tr>
<th>Location</th>
<th>Nicholson and Scadding</th>
<th>d'Abreu et al.</th>
<th>Tuttle et al.</th>
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<td></td>
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<td>Vertebral Body</td>
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<tr>
<td>TOTAL</td>
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<td>50</td>
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### ROENTGEN FINDINGS

The late roentgen findings in relation to intrathoracic metallic foreign bodies are quite variable. Some patients who have had severe penetrating through-and-through injuries of the chest, with a sucking pneumothorax, etc., may have one or two residual intrapulmonary fragments and no other significant changes; scarring may be so minimal that it is only visible in the most perfect of stereoscopic roentgenograms. On the other hand, a small jagged fragment which happened to sever an intercostal
or other artery, and was followed by extensive intrapleural or extrapleural hemothorax, secondary infection, pleural fistula and so forth, may be associated with advanced pulmonary and pleural scarring, etc. The changes incidental to hemorrhage and infection constitute the main factor in the production of any late roentgen changes. In the absence of such complications, a large metallic foreign body may remain benignly in lung tissue for apparently indefinite periods.\textsuperscript{2,9,15} One writer\textsuperscript{15} reported several cases of bullets lying in the lung without the formation of a fibrous tissue capsule around them; in the case of shell fragments we believe that a capsule is almost always present.

During the past three years we have made roentgen examinations of over 150 men with intrathoracic metallic foreign bodies from one to twelve months following injury. The vast majority of these were seen between three and five months following wounding, and several were observed for periods of another three months. Most of them were cases with intrapulmonary metallic foreign bodies, the fragments varying from less than 1 to as much as 40 mm. in length, and from 1 to 30 mm. in diameter. Approximately 25 per cent of the cases had fragments 1 cm. or over in diameter (a finding which is of some interest in view of d'Abreu, Litchfield and Hodson's opinion\textsuperscript{3} that fragments of this size should be removed).

About 20 per cent of our cases had associated bony injuries, usually rib fractures, often healed by the time the patients were referred for roentgen examination at our hands. Approximately 75 per cent of the cases showed residual pleural changes (thickening, scarring and so forth). Only about 15 per cent showed pulmonary changes... that is, pulmonary changes demonstrable with ordinary roentgen technique; with superlative technique the presence of fine pulmonary scars would undoubtedly have been shown in a much higher percentage of cases. Since such scars usually have no clinical significance, their detection cannot be regarded as very important. About 10 per cent of the cases showed no significant residual pleural or pulmonary changes.

Only a few of our cases had mediastinal or pericardial foreign bodies, and but one was intracardiac. None showed evidence of aortic or esophageal perforation. A few were intrasosseous (rib or vertebra). The majority of the cases were due to shell or mortar fragments.

**SYMPTOMS AND SIGNS**

The late symptoms produced by intrathoracic metallic foreign bodies are extremely difficult to evaluate.\textsuperscript{1,3,5,6,14} In general, if there is no secondary chronic infection and the patient is unaware
that he retains a missile, symptoms tend to be absent. Some patients complain of vague chest pain, hemoptysis, shortness of breath and so forth. If the fragment is near the periphery of the lung, thoracic pain might reasonably be ascribed to its presence, although we have seen several instances of such location without pain. Hemoptysis may apparently occur from some retained shell fragments; we recollect none in the present series. The evaluation of alleged dyspnea is almost impossible. As Blades and Dugan have pointed out,¹ such symptoms often disappear if the patient is shown the postoperative roentgenogram following removal of even a small foreign body!

Fairly severe clinical symptoms were evident in or were claimed by approximately 10 per cent of the cases in our series; slight symptoms by another 10 per cent and virtually no symptoms by the remaining 80 per cent. Provided their attention was not directed to the metallic object and leading questions were eschewed. These figures have some significance, since many of these patients were naturally anxious to secure release from military service and were apt to stress pulmonary symptoms. Almost all of them knew that they had scars on their chest walls and the majority suspected or knew they had received some intrathoracic fragments. The presence of severe associated injuries such as compound fractures of the arms or legs, penetrating abdominal lesions and facial injuries frequently served to distract the patient’s attention from worrying about a mild transitory cough or similar symptom.

Small, silent foreign bodies in the lungs are seen fairly often in civilian roentgenological practice. They commonly consist of pins, or needles and small calibre missiles. After the initial period is passed, and in the absence of complications, these small objects tend to remain unchanged and asymptomatic for an indefinite length of time. A few may migrate and cause subsequent pericardial, cardiac or other visceral disturbances.⁶

Large, silent intrathoracic metallic objects were considered to be a rarity, but we have now seen several such cases—jagged metallic objects as large as 3 cm. in diameter in patients without pulmonary symptoms, and whose films showed little or no scarring in the vicinity of the missile. The lung tolerates these quite well (in inverse proportion to the manner in which it tolerates organic substances such as clothing, bone splinters, etc.).

COMPLICATIONS

The early complications of intrathoracic metallic foreign bodies are well known and will not be discussed here. The late complications include migration and disintegration of the object, erosion
Figure 1A. (Case No. A2597): Large, irregular intrapulmonary foreign body (bomb fragment). Aviation Machinist’s Mate, age 24, blown overboard aircraft carrier in March, 1945. Original diagnosis: Multiple wounds of chest and left lower leg, with compound fracture of tibia; rupture of left tympanic membrane. Hemopneumothorax.—Physical examination, July, 1945: Multiple healed shrapnel wounds over chest; healed incisional scar over the right tenth intercostal space and healed wound over the right seventh rib, anteriorly. No pulmonary findings.—X-ray (July, 1945): Metallic foreign body, 16x8x25 mm. in mid-portion of left lower lobe, without visible surrounding reaction; minimal thickening of some of the pulmonary markings in a small portion of this lobe.—Course: Complete resolution of hemopneumothorax; no chest symptoms at present time; patient sent on convalescent leave.

Figure 2A. (Case No. A1923): Large, irregular intrapulmonary foreign body (shell fragment). No significant pulmonary reaction now visible, despite fragment traversing the entire lower lobe and half of the adjacent middle lobe. Sergeant, age 26, wounded on board ship, March, 1945.—Physical examination, June, 1945: Negative, except for scar on the right posterior thoracic wall.—X-ray (May, 1945): Metallic foreign body, 19x6x13 mm. in anterior portion of right middle lobe, without surrounding pulmonary reaction; slight pleural thickening around the inferior and lateral aspect of this lobe.—Course: Uneventful; returned to duty, June, 1945.
of blood vessels, recurrence of infection and the development of herniae (phrenic, mediastinal, etc). Pleural irritation, phrenic nerve pressure and so forth may also eventuate. Forsee et al. describe pulmonary suppuration as a late complication of retained foreign bodies. We have seen no such instance.

Smooth slender objects may migrate and cause subsequent pleural, pericardial or other visceral disturbances, potentially grave. Therefore, should the patient have, for example, a smooth sharp-nosed bullet in the lung, it might be advisable to consider radiographing his lungs at annual intervals (or sooner if symptomatic) in order to observe early signs of migration.

Foreign bodies composed mostly or largely of lead may disintegrate after many years and be associated with symptoms of lead poisoning; we do not know of recorded instances of such occurring in connection with intrapulmonary objects, but have seen a few cases in connection with intramuscular or intraarticular lead

![Figure 3A](image1.png)  ![Figure 3B](image2.png)

Figure 3. (Case No. A1748): Large, smooth intrapulmonary foreign body (≈ 30 caliber bullet). Corporal, age 23, wounded on Iwo Jima, February, 1945. The bullet entered the left fourth intercostal space about 3 cm. to the left of the sternum. The patient had slight shock and hemoptysis but no respiratory distress.—Physical examination, April, 1945: Negative, except for the presence of a small healed scar at the point of entry.—X-ray (April, 1945): Bullet, about 30 caliber size, in right upper lobe near hilum, without visible surrounding reaction; fluoroscopic examination discloses no vigorous movement of this bullet; it is therefore presumably not in close relation to a large vessel.—Course: This patient had few symptoms and underwent prompt healing, despite the fact that the bullet must have traversed the mediastinum before ending up in the right upper lobe. He was ready for duty one month after the incident, but was returned to the continental limits for final study and disposition.
fragments. On the whole, this contingency must be extremely remote, since numerous persons have had small pieces of lead shot in their tissues for several decades and never shown clinical evidence of lead poisoning.

Erosion of blood vessel wall appears to be quite uncommon. We have seen one case of late, massive (and fatal) hemoptysis in a patient with a small intrapulmonary metallic fragment. The episode occurred following spontaneous rupture of a vessel wall damaged presumably by the passage of the object; at necropsy the latter did not lie near the torn vessel, and therefore the incident cannot be ascribed to the continued presence of the metallic foreign body in the lung.

One of the complications of penetrating injury reported in recent years is extrapleural hemothorax. In late cases such is rarely evident and would be difficult to differentiate such from intrapleural bleeding, pleural thickening and so forth. However, in early cases the following characteristics of extrapleural hemothorax have been reported: The effusion is almost always localized to a portion of the chest wall, and not spread diffusely up

![Figure 4A](image1.png) ![Figure 4B](image2.png) ![Figure 4C](image3.png)

*Figure 4. (Case No. A1721): Large, smooth subpleural (? phrenic) foreign body—30 caliber bullet. Corporal, age 22, wounded at Iwo Jima, February, 1945. The bullet entered the left lower anterior chest about 2 cm. lateral to the midsternal line, at the sixth intercostal space; it presumably traversed the left lobe of the liver and the hemidiaphragm. Patient was unconscious for three days; had a bloody sputum for about a week and was given a diagnosis of blast concussion; he was described as moribund on evacuation.—Physical examination, April, 1945: Evidence of left hydro-pneumothorax; healed scar over left lower anterior thorax.—X-ray (April, 1945): Large, smooth metallic foreign body imbedded in or close to the posterior one-third of the left hemidiaphragm; fixation of the latter. Left hydro pneumothorax, with about 50 per cent collapse of the lung; dense pleural thickening around left lower lobe, with adhesions. Barium examination of esophagus and stomach revealed no abnormality.—Course: After an initial stormy period, with massive hemothorax, he slowly improved. He was given much oxygen, plasma, penicillin, and so forth; he developed some complications, including apparent rupture of a left subphrenic abscess into the splenic flexure of the colon. In September, 1945, he was convalescent and in good shape.*
or down. Its margin may arise gently or abruptly; in the latter instance it may give the appearance of overhanging at its inferior margin. Such a lesion will indent the lungs, sometimes for several centimeters. When located in a region such as the apex, it has a tendency to overlie the lung like a cap. It varies in size from a small "blister" to a large rounded collection, as much as 15 cm. in diameter. There is almost always some damage to adjacent ribs. Some cases may, of course, be accompanied by an intrapleural effusion or hemothorax.

A possible development which we have not experienced is the production of intrapulmonary arterio-venous fistula—from early or late erosion of the walls of adjacent pulmonary vessels.

REMOVAL

The question of the late removal of foreign bodies is apparently difficult to decide, despite the fact that most appear to be innocuous. Some authors now believe that those in the outer two-thirds of a lung may be left alone, while those more centrally located should, in general, be removed. Antral (hilar), mediastinal and cardiac foreign bodies are more apt to be fatal and hence much less commonly seen than the first mentioned type.
especially in the later months after wounding. Holman\(^9\) believes that the late removal of metallic foreign bodies in the lung depends largely on their size and whether the symptoms complained of may be attributed to their presence; those in the heart should be removed if symptom-producing.

Tuttle, Langston and Crowley\(^{14}\) reported that during the African and Sicilian campaigns a size limit of 7 mm. was set as the criterion for removal, subject to restrictions of location; later, in the Italian campaign, the limits were gradually increased to 1.5 cm. (unless smaller fragments presented a menace to life). Incidentally, in direct contrast to King\(^{11}\)—who found intrapulmonary abscesses around metallic foreign bodies in 4 out of 10 cases operated upon—Tuttle et al. found no instance of lung abscess, although the foreign body was often surrounded by a hematoma into which had been carried pieces of clothing, etc. In 68 cases with retained bodies, removal was deemed indicated in 44. Under combat conditions, early removal had poor results in 31 per cent of cases while late removal (after three weeks) had such in only 3 per cent. In summary, they believe that the mere presence of even moderate-sized foreign bodies in the lung is not necessarily an indication for removal; that symptom-producing bodies in the heart and lung should be removed; and that early removal is indicated in those involving the posterior mediastinum and diaphragm.

![Figure 6A](Image of Small, smooth intrapulmonary foreign body (explosive bullet fragments). Private, age 20, struck by sniper bullet on Iwo Jima, February, 1945. Developed "sucking" wound of chest, with massive right hemothorax and fracture of right fourth rib. Physical examination, July, 1945: Essentially negative, except for small scar over right chest wall and evidence of pleural thickening. X-ray (July, 1945): Multiple metallic foreign bodies in the right antero-lateral chest wall; pleural thickening around the right lung, notably laterally. Metallic foreign body, 10 mm. in diameter, in right lobe of liver. Course: Following multiple thoracentes of bloody fluid, transfusions and etc., the patient improved steadily. Returned to duty July, 1945.)

![Figure 6B](Image of X-ray showing metallic foreign body in right lobe of liver.)

![Figure 6C](Image of X-ray showing metallic foreign body in right lobe of liver.)
In a group of ninety-two patients with “acute” intrathoracic metallic fragments or bullets recently reported by d’Abreu et al., fifty were subjected to immediate operation “because of the danger of infection, hemorrhage and additional structural damage.” Foreign bodies were removed from the lung in one-half the cases, from the pleural cavity in fourteen and from the mediastinum or pericardium in seven; in the remaining four they were removed from the “endothoracic fascia”. There was a mortality of 4 per cent.

On the other hand, Nicholson and Scadding report 15 cases with retained intrathoracic metallic foreign bodies for periods exceeding 12 months, only one of whom had symptoms (hemoptysis, apparently due to a large shell fragment), and eleven of whom were still on active duty: the other three had been discharged (no reason given).

Blades and Dugan “endeavor to individualize each case” in the light of the following factors: (1) whether the fragment in the lung produces symptoms, (2) the size and position of the fragment, and (3) the psychosomatic effect on the patient who knows he has a shell fragment in his lung. They state that they believe

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**Figure 7A**

Small, irregular intrapulmonary foreign bodies (mortar shell fragments). Sergeant, age 26, wounded in March, 1945—multiple small wounds in chest wall and left thigh.—Physical examination, June, 1945: Chest negative, except for two small scars in the left upper anterior thoracic region.—X-ray (May, 1945): Two tiny metallic foreign bodies in left upper lobe at level of third space anteriorly; one moderate-sized fragment in subcutaneous tissues over manubrium sterni. Lungs otherwise clear.—Course: Despite the minute nature of the fragments and the relatively light nature of the injury, this patient allegedly developed severe dyspnea and chest pains lasting for some weeks following the injury. The small subcutaneous fragment was removed in June, 1945, and his chest was clinically well in September of that year. Sent to convalescent hospital.
that "size alone is not a reliable criterion on which to base the
decision to remove a foreign body," and yet add "obviously, the
large shell fragment should be removed". Of 30 patients with
intrapulmonary shell fragments observed at Walter Reed General
Hospital, 16 were subjected to surgical removal thereof. Of these
only 12 showed "definite signs or symptoms which could be at-
tributed to the foreign body," while 4 showed symptoms "probably
psychosomatic in origin". In the remaining 14 cases in which
operation was not advised the fragments "were small, in most
instances multiple, and the patients had no complaints"

After observing the late cases reported in this article, it is our
impression that the vast majority of intrapulmonary metallic
foreign bodies do not require removal. In passing, it is rather
curious but interesting to note that several authors report
that calcified nodes may easily be mistaken for metallic foreign
bodies both prior to as well as at operation.

Figure 8A
Figure 8B

Figure 8. (Case No. A2578): Small, irregular extrapulmonary foreign body
(bullet fragment). Private, age 23, with gun shot wound of right side of chest
sustained at Okinawa, June, 1945.—Physical examination, July, 1945: Healed
scar, 3 cm. long, on right thoracic wall just below and lateral to the inferior
angle of the scapula. Evidence of thickened pleura around right lung.—X-ray
(July, 1945): Metallic foreign bodies in subcutaneous tissues behind and on
right side of 10th and 11th thoracic vertebral bodies; thickening of the mark-
ings (scarring ?) in right middle and lower lobe; thickened pleura around
these lobes.—Course: Immediately after injury, the patient's wound was de-
brided but the pleura not entered. He had hemoptysis for two days and x-ray
evidence of right hemothorax, but no thoracentesis done. Clinically well in
August, 1945, and sent on convalescent leave.
ILLUSTRATIVE CASES

The roentgenograms of a series of ten illustrative cases with intrathoracic metallic foreign bodies and penetrating wounds of the thorax are reproduced with this paper. The legends attached to the prints give the essential clinical and roentgenological data on all cases and, for purposes of brevity, these data will not be repeated in the text. Nine of the ten cases shown had, at the time of our particular roentgen examinations, normal blood counts, normal sedimentation rates, negative urine findings and negative laboratory findings of other types. Only one case, No. A1721, who had a residual hydropneumothorax, showed an elevated white count and a slightly increased sedimentation rate at the time of our examination.

SUMMARY

Intrathoracic (pulmonary) metallic foreign bodies are frequently innocuous, especially in the late stages (three or more months following injury).

These foreign bodies may have little or no associated pleural or...
pulmonary scarring, and, even though in close proximity to a large bronchus, often have no associated pulmonary symptoms.

The necessity for removing most metallic intrapulmonary fragments merely because they measure 1 cm. or more in diameter is not borne out by the series of cases reported herewith.

Organic material (notably bone fragments) driven into the lung at the time of injury, is apparently a much greater source of potential trouble than the metallic foreign body itself.

RESUMEN

Los cuerpos extraños metálicos intratorácicos (pulmonares) son frecuentemente inocuos, especialmente en los periodos avanzados (tres meses o más después del traumatismo).

Estos cuerpos extraños pueden estar acompañados de poca o de ninguna cicatrización pleural o pulmonar y, aun cuando están muy próximos a un bronquio grande, frecuentemente no causan ningún síntoma pulmonar.

Figure 10A

Figure 10B

Figure 10. (Case No. A1922): Penetrating through-and-through lung injury (bullet). Private, age 22, hit by sniper bullet on Iwo Jima in March, 1945. The bullet entered the chest 3 cm. mesial to the right nipple and ranged downward; no wound of exit could be seen.—Physical examination, July, 1945: Small, healed scar over right anterior chest; healed mid-line abdominal scar; evidence of pleural thickening at right base, anteriorly.—X-ray (July, 1945): No metallic foreign body visible. Right basal pleural thickening especially anteriorly and laterally. Lungs otherwise clear.—Course: The patient given an emergency laparotomy for hemorrhage; laceration of the liver was found and sutured, and a bullet in the peritoneal cavity removed. He showed steady improvement and returned to duty in July, 1945.

(The dotted line in the illustrations indicates the estimated course of the bullet; note the complete absence of pulmonary scarring.)
La necesidad de extraer la mayor parte de los fragmentos metálicos intrapulmonares simplemente porque midan un centímetro o más en diámetro, no se constató en la serie de casos incluidos en este informe.

Materias orgánicas (especialmente fragmentos de huesos) que penetren el pulmón con el cuerpo extraño metálico durante el traumatismo, aparentemente pueden ser causa de mucho más daño que el cuerpo extraño mismo.

REFERENCES