

GREASE-GUN INJURIES

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A REPORT based on two cases has limited value, but in uncommon conditions even a single record may add to our knowledge of a subject, especially when conflicting advice has been given concerning treatment.

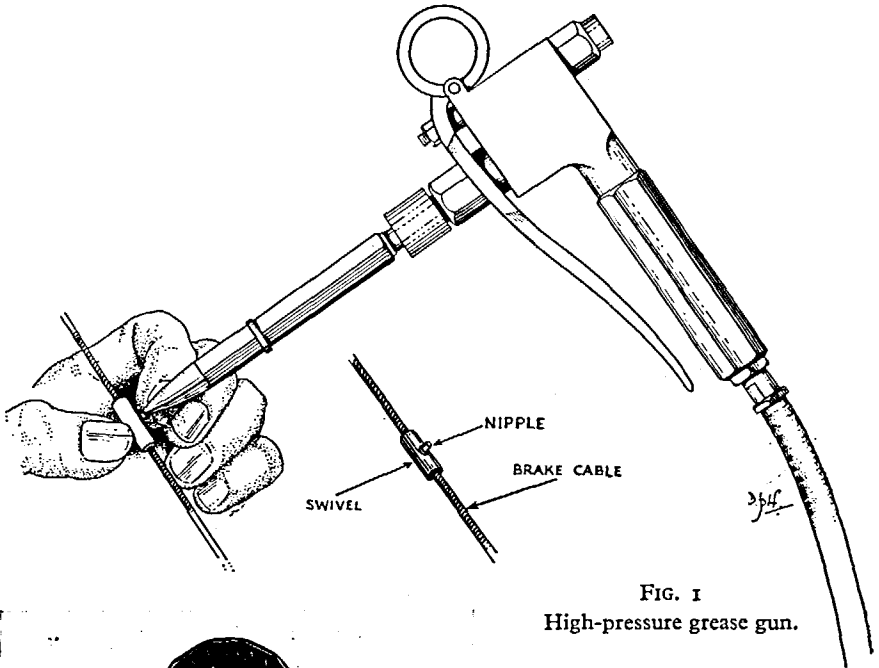


FIG. 1
High-pressure grease gun.

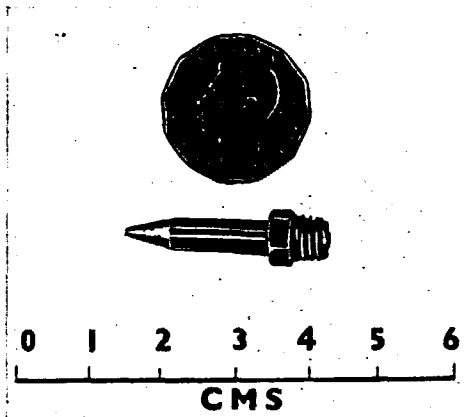


FIG. 2
The nozzle of a high-pressure gun
compared with a threepenny piece.

Figs. 1 and 2 show a high-pressure grease gun which delivers grease at the pinhole nozzle under a pressure of 2,000 lb. per sq. in. as a fine spray which may penetrate the tissues like a needle and fill a finger in the split second before

it can be pulled away. The gun need not be in contact with the skin for this to happen.

Both the present cases occurred in the same garage and with C. C. Wakefield's Castrolease Medium, which contains 10 per cent. lime soap and 90 per cent. mineral oil with a viscosity of 145 sec. at 140° F.

The accident is usually caused by the nozzle of the gun slipping off the nipple of the brake while the trigger is still being pressed, and the jet of grease enters a finger of the hand holding the brake.

PATHOLOGY

The effects of grease and diesel oils on the tissues are similar and may conveniently be divided into three stages :—

1. Immediate.—The entry of the foreign material causes an instantaneous swelling of the fingers and an increased interstitial pressure which may be followed by vascular obstruction and gangrene. The tissues become white, tense, and anaesthetic. Hughes (1941) has also suggested that a massive thrombosis of blood-vessels may occur when a jet of oil suddenly volatilises under tremendous pressure, giving rise to a more widespread gangrene than would be expected from a comparatively small injection.

2. Reactionary.—The foreign material causes chemical irritation followed by inflammation and sterile abscesses; or, if the tissues become secondarily infected, sloughing and necrosis of the skin and deeper tissues may occur. Throbbing pain is intense during this period. Dial (1938) injected fuel oil subcutaneously into rabbits, and each experiment resulted in a sterile abscess with local inflammation.

3. Late.—(a) If the grease is near the skin, within a few weeks multiple small pits appear and a creamy foul-smelling substance is intermittently discharged.

(b) If the grease lies deeper, it may become encapsulated in fibrous tissue containing whorls of fibroblasts, foam cells, plasma cells, and polymorphonuclear leucocytes. Cyst-like spaces also occur filled with grease and lined with flattened connective tissue cells. If the process becomes excessive, benign tumour-like formations of fibrous tissue appear similar to the oleomas and paraffinomas of early thoracic and plastic surgery, which may require excision and replacement by a graft or flap.

CASE HISTORIES

Case 1.—P. M., a garage hand, accidentally tripped the trigger of a high-pressure gun when the pulp of the middle finger of the right hand was against the nozzle. The point of the gun appeared only to scratch the skin and there was no pain, but because of the accident to a friend, T. A., seven years before, the patient reported to a doctor within twenty minutes and received an injection of abbocillin R/R (400,000 units), a slow-acting penicillin preparation containing penicillin G procaine (300,000 units) and penicillin G potassium (100,000 units). The pinhole entry wound healed in a day or two.

On the third day after the accident the finger began to swell and throb and felt tense, though it was not painful enough to keep him awake at night.

On the fourth day the terminal interphalangeal joint became stiff. A second injection of abbocillin R R (400,000 units) was given, and a kaolin poultice was applied twice daily for three days. The finger became steadily worse.

On the tenth day the patient reported to hospital. The affected finger was very pale except around the entry wound in the pulp, which had broken down and was red and



FIG. 3

Case 1. Lateral radiograph of the middle finger showing grease in the soft tissues.

tender. A hard fusiform swelling extended from the level of the base of the nail to the middle of the proximal compartment and prevented all movement of the distal

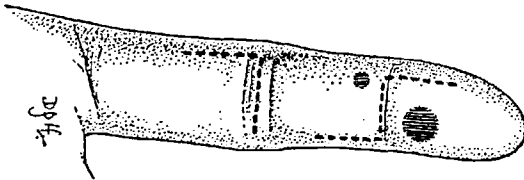


FIG. 4A

Case 1. Diagram of the volar aspect of the finger showing incisions.

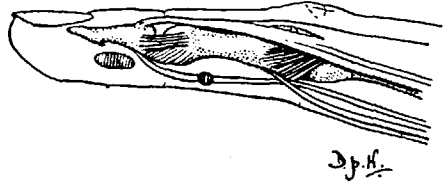


FIG. 4B

Case 1. Diagram of lateral view of the finger showing sites of grease beads.

interphalangeal joint, which was held in 15 degrees of flexion, and allowed about 10 degrees of active or passive movement at the proximal interphalangeal joint. The finger was clumsy and numb, except for a burning sensation in the midline of the terminal compartment.



FIG. 5

Case 1. Bead of grease escaping from thin surrounding capsule.

A radiograph showed a clear-cut transparent area in front of the proximal end of the distal phalanx, and an indefinite translucency anterior to the middle phalanx (Fig. 3).

The same day the finger was explored in a bloodless field through a bayonet incision based on the distal volar digital crease (Fig. 4). Beneath the flap over the finger pulp a few minute globules of grease were visible in the subcutaneous tissue which was stained uniformly yellow. About 3 mm. beneath the skin a thin fibrous sac was found, and on nicking it a bead of grease some $\frac{3}{4}$ c.c. in volume exuded quickly at first and then more slowly, as if it had initially been under pressure (Fig. 5).

The flap over the middle compartment was then raised and a smaller bead of grease, surrounded by a thin membrane, was found and removed. The proximal

interphalangeal crease was explored through a second incision and the tendon sheath opened, but the tissues at this level were normal. The wounds were closed and a small nylon drain was inserted into the digital incision. At the end of the operation the woody induration was no longer apparent and there was full passive movement at both

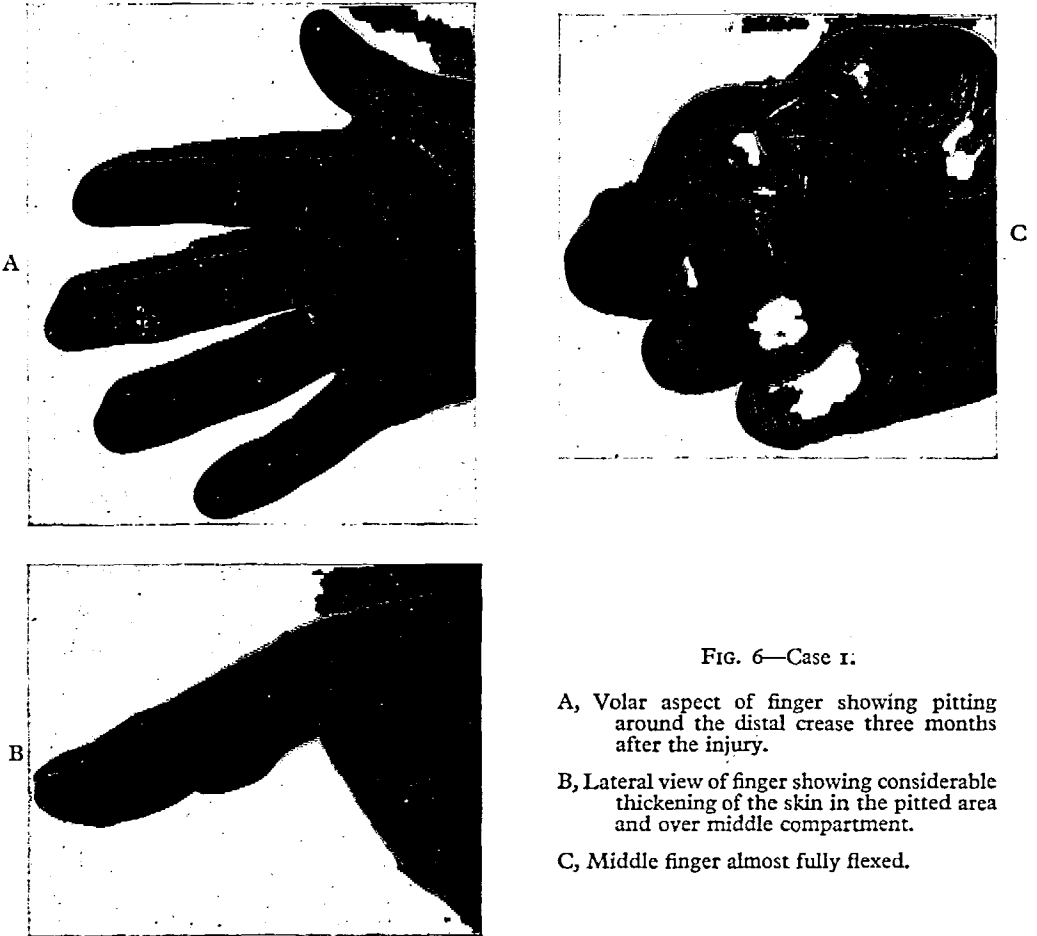


FIG. 6—Case 1:

- A, Volar aspect of finger showing pitting around the distal crease three months after the injury.
- B, Lateral view of finger showing considerable thickening of the skin in the pitted area and over middle compartment.
- C, Middle finger almost fully flexed.

interphalangeal joints. Penicillin (100,000 units) was given intramuscularly every six hours for five days.

Post-operative Progress.—The finger was very painful that evening, and for the first time morphia was required. After forty-eight hours the drain was removed and the finger had regained its normal colour.

On the eighteenth day the cuticle around the distal crease separated. The incision had nearly healed and there was 45 degrees of active movement at the proximal interphalangeal joint and 15 degrees at the distal.

On the twenty-eighth day the skin had healed, but five days later a cheesy material began to exude from a small area of breakdown in the distal incision, and the surrounding skin was indurated and hard.

The patient returned to work at the end of two months wearing a leather finger-stall, and Fig. 6 shows this finger a month later. The skin of the middle compartment near the

distal interphalangeal crease was thickened, indurated, and contained several pits; and on squeezing the finger little ribbons of whitish creamy material appeared, some up to 1 cm. in length and about $\frac{1}{2}$ mm. in diameter, which smelt similar to the contents of a sebaceous cyst, and on culture grew only a few colonies of *Staphylococcus albus*.

At four and a half months a little creamy material could still be expressed. The finger had recovered its full range of movement. The possibility of excising the indurated area of skin and replacing it with a graft or a cross-finger flap has been discussed with the patient, but so far the disability is considered to be too slight to require intervention.

Case 2.—Eight years ago T. A. had a similar accident in the same garage, using the same gun and the same brand of grease. The nozzle slipped off the brake nipple and pierced the volar aspect of the proximal compartment of the right index finger and passed around the lateral side of the phalanx, injecting grease only into the dorsum of the finger.

At first there was no pain and no limitation of movement, though the finger became white, tense, and cold. At the end of twenty-four hours the finger was swollen, especially around the metacarpo-phalangeal joint, and was very painful.

Poultices were applied, but the finger remained tender for about six months and prevented him from working. At the end of this time the skin over the dorsal aspect of the proximal phalanx became thickened and pits appeared, from which a foul-smelling whitish substance discharged for several months. Intermittently the patient had to stay away from work.

After two years he reported to a hospital with a "septic finger." The brief operative

note reads: "Scar tissue excised. Skin flaps reflected back on both sides. Wound sutured under tension with silkworm gut." Healing was satisfactory and was followed by physiotherapy and exercises. Altogether he lost nearly a year's wages.

The final complete recovery of function is shown in Figs. 7B and 7C.

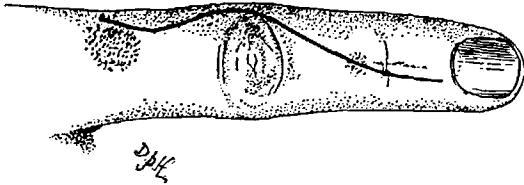


FIG. 7A

Case 2. Drawing of the faint scar on the dorsal aspect of the finger eight years after operation, and two areas (heavy stipple) where the skin is still a little pitted.

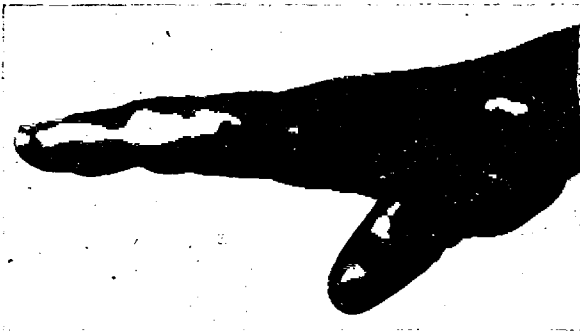


FIG. 7B

Case 2. Index finger fully extended.



FIG. 7C

Case 2. Index finger fully flexed.

DISCUSSION

The following six cases from the literature are reviewed and used to present a fuller clinical picture of the condition, and to stress the importance of early adequate incision. Diesel oil injuries are not discussed, but a short bibliography is included for reference, and in these closely related injuries Rees (1937) and Dial (1938) both recommend early operation.

Smith (1939) reported a grease injection into the base of an index finger which immediately became numb. Four cubic centimetres of thick grease were expressed from the small entry wound. Next day the hand was swollen and very painful. A lateral incision was made in the finger and 15 c.c. of grease removed ($\frac{1}{2}$ oz.). Magnesium sulphate compresses were applied. Wet gangrene followed, and so dry heat was used, but the distal and middle portions of the finger became dehydrated into oily masses of insensitive tissue.

Amputation through the metacarpo-phalangeal joint was performed on the ninth day and the skin flaps left open. Thirty cubic centimetres of grease (1 oz.) were expressed from the palmar space and 15 c.c. ($\frac{1}{2}$ oz.) from the wrist. The wound healed slowly and small amounts of grease appeared on the dressing for five weeks. The patient returned to work at the end of two months, though he had transient œdema of the hand following any hard work. The specimen was examined microscopically and showed numerous subcutaneous abscesses infiltrated by myriads of polymorphonuclear leucocytes. There was marked necrosis of the subcutaneous connective tissue. In some areas there was fibroblastic proliferation and foreign-body giant cells. Fat stains revealed occasional small droplets of fat along the periphery of the abscesses. This appears to have been the most severe grease-gun injury so far described. It is easy to be wise after an event, but 4 c.c. of grease were expressed through a small entry wound and 60 c.c. left behind. Had the finger and the palm been widely explored soon after the accident more grease would have been removed and the final outcome might have been different.

Brook and Rooke (1939) described two cases. The first was an injury to a finger tip which became infected and drained pus until a sequestrum was removed. The second, also an injured finger tip, was treated by a small ineffectual incision made over the puncture wound, but no grease could be expressed. On the fourth day the finger became indurated and black to the terminal interphalangeal joint.

On the ninth day the finger doubled in size and the skin distal to the proximal interphalangeal joint was lifted up from the underlying tissue by a watery fluid. Next day it was removed and slow recovery followed.

Mason and Queen's (1941) report on two cases mentions the grease penetrating some rags before entering the palm of their first patient, while the second was injured when the nozzle was 8 in. away from the pulp of the left index finger. At operation a small incision was made, but no grease escaped. The wound took several weeks to heal. One month later the finger tip enlarged slowly and became hard, and six weeks later a few small pitting scars appeared. The tumour was removed, together with the overlying skin, and the defect closed with a small pedicle flap.

Byrne (1944) reported a grease injection into the pulp of a ring finger which immediately became swollen and numb. An hour later a *small* incision was made over the entry wound and a little grease expressed. On the third day the fingers

and palm were very swollen and there was intense throbbing. Massive warm wet packs were applied. On the sixth day the distal half of the finger was blue-black, the rest being pink. On the ninth day a scanty purulent discharge began from the incision and the viability of the middle and distal phalanges was doubtful. Finally only the terminal 1 cm. of the finger was lost. The rest of the finger was indurated, but full movement had returned by the end of six weeks. Translucent areas in the skin continued to break down and discharged a waxy material, leaving small pockets in the skin. X-ray examination showed some osteoporosis of the phalanges of the injured finger.

In conclusion, Byrne advised against hot soaks as being liable to raise the metabolism of an already anoxæmic member; against longitudinal incisions because of the further damage to impoverished tissues, and also because he believed the grease to be widely dispersed "and it was doubtful if it could be removed by such incisions"; and against early amputation since the final necrosis in his case was far less than had at first appeared possible, and he suggested a parallel with the conservative treatment of frostbite.

He advocated restricting surgery to the removal of slough, the incision of fluctuant areas and abscesses as and when they occurred, and the excision of subcutaneous oleomas or involved skin, with coverage of the defect by a graft.

From the experience of the two cases now reported some modification of Byrne's conclusions appears advisable.

In the first case a dramatic change occurred immediately after the removal of only 1 c.c. of grease. Full passive movements of the interphalangeal joints returned and the tense woody feeling of the tissues disappeared. I believe the release of the interstitial pressure allowed the blood to circulate normally again and prevented the progress of an impending gangrene. When the finger was examined at the first dressing two days after the operation, the skin had regained its normal colour.

The grease is not always widely dispersed through the tissues, as Byrne suggested. Perhaps this depends upon the site of the injection or the type of grease. A radiograph may give valuable pre-operative information (Fig. 3).

The second patient's long period of discomfort and loss of earning power terminating in an operation at the end of two years does not recommend conservative treatment, and early removal of the grease seems to be indicated.

SUMMARY

1. Two comparable cases of grease-gun injuries are described, the first treated conservatively and the other by immediate surgery.
2. The long inactivity arising from an apparently trivial injury is stressed.
3. A bayonet incision was found to give an adequate exposure without the formation of a "bow string scar."
4. On removing only 1 c.c. of grease there was a marked reduction in the tenseness of the finger, with immediate restoration of full passive movements of the interphalangeal joints.

APPENDIX

An attempt was made to assess the frequency of the accident by visiting six of the larger garages in Newcastle. At two, the works foremen were unaware of

the possibility of grease-gun injuries ; at another two they knew the danger and allowed only certain trained men to use the guns. No grease-gun injuries had occurred in these four garages in the last ten to twelve years.

At the fifth garage visited, the foreman said an accident occurred about every eighteen months, and at the sixth garage two injuries had occurred in eight years (the patients described in this paper).

I wish to thank Mr Fenton Braithwaite and Professor F. H. Bentley for their advice and criticism in the preparation of this paper ; Mr D. P. Hammersley for his drawings ; the Department of Photography, King's College, for the use of their records ; and Messrs C. C. Wakefield for the information concerning their product, Castrolase Medium grease.

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