- Farree, C. E., Rand, G., and Lewis, E. F. (1935). *Arch. Ophthalm.*, N.Y., **13**, 212.
 (1938). *Ibid.*, **20**, 58.
 Frandsen, H. (1935). *Acta ophthalm.*, Kbl., Supp. 4, 1.
 Frenkel, H. (1916-17). *Arch. Ophthalm.*, Paris, **35**, 577.
 Gelenczér (1916). *Arch. Augenheilk.*, Erg. H., **81**, 53.
 Hillemanns, M. (1918). *Klin. Mbl. Augenheilk.*, **61**, 456.
 Hofe, K. von, and Glees, M. (1940). *Ibid.*, **104**, 369.
 Hölscher (1918). *Inaug. Diss.*, Bonn.
 Hübener (1917). *Arch. f. Ophthalm.*, **93**, 360.
 Jeans, P. C., and Zentmire, Z. (1934). *J. Amer. med. Ass.*, **102**, 892.
 (1936). *Ibid.*, **106**, 996.
 Jeghers, H. (1937). *Ann. intern. Med.*, **10**, 1304.
 Jess, A. (1921). *Zbl. ges. Ophthalm.*, **6**, 1, 113.
 Junius (1916). *Z. Augenheilk.*, Orig., **36**, 49.
 Koeppel, L. (1917). *Ibid.*, **38**, 89.
 Landolt, M. (1917). *Arch. Ophthalm.*, Paris, **35**, 580.
 Löhlein, W. (1916). *Münch. med. Wschr.*, **63**, 910.
 Maitra, M. K., and Harris, L. J. (1937). *Lancet*, **2**, 1009.
 Meyer, H. (1918). *Z. Augenheilk.*, **39**, 48.
 Nagel, W. A. (1907). *Ibid.*, **17**, 201.
 Néchitch, G. P. (1918). *Ann. oculist.*, Paris, **155**, 172.
 Park, I. O. (1935). *J. Oklu. med. Ass.*, **28**, 357.
 Paul (1915). *Münch. med. Wschr.*, **62**, 1548.
 Pillat, A. (1940). *Ibid.*, **87**, 225.
 Rauch, R. (1916). *Ibid.*, **63**, 1521.
 Sattler (1918). *Ber. Versamml. ophthalm. Gesellsch.*, Heidelberg, p. 231.
 Savo Goiu (1922). *Rev. Sanid. milit.*, B. Aires, **20**, 3.
 Schieck, F. (1918). *Dtsch. militärärztl. Z.*, **47**, 178.
 Schuck, C., and Miller, W. O. (1938). *Arch. Intern. Med.*, **61**, 910.
 Semeonoff (1941). *Brit. J. Psychol.*, **32**, 136.
 Smith, H. (1921). *J. Amer. med. Ass.*, **17**, 1001.
 Sweet, L. K., and Kang, H. J. (1935). *Amer. J. Dis. Child.*, **50**, 699.
 Truc, H. (1916). *Montpel. Méd.*, **39**, 269.
 Uthoff, W. (1916). *Berl. klin. Wschr.*, **53**, 5.
 Weekers, L. (1916). *Bull. Acad. Méd.*, Paris, **75**, 361.
 Wessely, K. (1915). *Münch. med. Wschr.*, **62**, 1698.
 Wiese, L. O. (1919). *Arch. Augenheilk.*, **85**, 168.
 Wietfeldt (1915). *Münch. med. Wschr.*, **62**, 1742.
 Wohlfarth, O. (1917). *Zur Frage der Hemeralopie*, Frankfurt.
 Wolffberg. (1916). *Arch. f. Ophthalm.*, **31**, 1884.
 Zade (1915). *Münch. med. Wschr.*, **62**, 800.

CLOSED-PLASTER TREATMENT OF BURNS OF THE EXTREMITIES

BY

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The treatment of wounds by closed-plaster technique has received much attention of recent years. I have recently had the opportunity of applying the same form of treatment to cases of burns of the extremities admitted to an E.M.S. base hospital.

Following enemy action at sea a number of cases with burns caused by steam were admitted to this hospital. Of these, one which showed partial and full skin loss in feet and ankles was treated by the closed-plaster method seventeen hours after injury. Treatment consisted in cleansing with saline and removing blisters. All burnt areas were covered with vaselined gauze, and plaster-of-Paris was applied from the tips of the toes to the knees. The patient made an uneventful recovery. Plasters were removed on the fourteenth day, when the burnt areas were found to be completely healed and ankle movements were full and painless. A large number of cases which were involved in the same incident were admitted to a hospital elsewhere and were treated by various well-accepted methods. The interval between injury and initial treatment was from twelve to twenty-four hours. Some of these cases developed sepsis, and several were transferred to this hospital, at periods varying from three to twenty-one days after injury, for further treatment.

After admission here the closed-plaster method was applied only to grossly infected cases in which there was no regression of sepsis, the affected limbs being extremely painful on movement and in all instances showing joint deformities. No other method of selection was used for this series. In this manner 16 cases were treated—a total of 26 limbs, consisting of 11 hands and wrists, 3 wrists, 8 feet and ankles, and 4 complete upper extremities. No other form of treatment was applied either externally or internally, with the exception of silver nitrate to burn down the occasional small granulations and liquid paraffin

to maintain pliability of skin after the plasters were removed.

In trying to assess the extent of full skin destruction in the earlier cases a great deal of difficulty was encountered, particularly because of the superimposed infection present. All areas had definitely suffered partial skin destruction. The only occasion on which full skin destruction could be ascertained was when cases required more than one plaster application. An estimate was made from the size of areas of clean granulation tissue seen at the first plaster change. But by this time a large amount of epithelization had undoubtedly taken place, so an accurate estimate of the initial full skin destruction could not be made. Later cases did not offer so much difficulty, as the infection was in a chronic phase and granulating areas were present where there had been complete loss. How much of this was due to destruction by burning and how much to superimposed infection cannot be stated.

Method of Application

All cases were handled in the operating theatre; burnt areas were cleansed with saline, either by douche or sponge, and surrounding undamaged skin with soap and water. The affected areas were then covered with two thicknesses of gauze impregnated with petroleum jelly or liquid paraffin. Plasters were applied, and an endeavour was made to obtain absolute immobilization of the affected part by including the joint above and below it in the plaster. This was not possible in two cases in which the skin of the elbows and upper arms was involved. Absolute immobilization could only have been obtained by shoulder spicas, which were not warranted owing to the general condition of both patients at the time of application.

The position in which joints were immobilized varied with the position of the burnt area and the possibility of contracture formation. It also varied with the anticipated duration of treatment in plaster, bearing in mind that at each plaster change all joints were to be put up in positions different from the previous ones, so as to ensure as much mobility as possible when the areas healed. Early cases, in which a short period in plaster was anticipated, were put up in such a position as entirely to counteract the possibility of contracture. Where longer periods of immobilization seemed likely this was not attempted at the first application, the position being improved at change of plaster so as to reach an optimum position gradually.

A difficulty which arose with the ordinary methods of applying plaster was the danger of injury to the newly formed epithelium by cutting instruments. This was avoided by the use of plaster slabs, especially for hands and forearms. In these cases a palmar slab was applied from the finger-tips to the upper forearm, and was moulded with the joints in the desired position. When this had hardened the edges were greased with petroleum jelly. A dorsal slab was then applied and an ordinary gauze bandage wrapped around the forearm. The hand portion was well moulded between the fingers, which were previously separated by pieces of cotton-wool between the finger-tips. Extensions were made to include the elbow-joint and arm when desired. In this way the plaster could be removed easily by separating the slabs. In cases of feet and legs a fairly thick posterior slab and then circular plaster bandages to a thickness which could easily be cut with a plaster-knife were applied. These plasters included the toes, leaving only the extreme tips available for inspection. Plasters were changed every ten to fourteen days, depending on the amount of discharge and the condition of the plaster. The following outstanding features were noticed during the course of treatment by this method.

Comparative Freedom from Pain

In 13 cases there was immediate relief from pain—so much so that the whole mental attitude of the patient was completely changed. Movements in bed were free and painless. The only complaints in some cases were a sensation of heat, especially in the fingers, for the first two or three days and a soggy inside the plasters several days after application. Previously in most cases strong analgesics had been necessary for the control of pain. It was possible to discontinue the use of these immediately, soneryl and aspirin sufficing to relieve insomnia where present.

In 3 cases, however, there was complaint of pain, but to a much less degree than before the application of plasters. In one of these, a case of burns of the feet and ankles, plasters were removed for investigation. This revealed considerable pocketing of pus under tan which had been applied as initial treatment. The tan was removed and plasters reapplied. This procedure was followed by complete relief of pain. The other two cases had extensive burns of both hands, forearms, and upper arms. These patients complained of pain not in the completely immobilized forearms and hands but in the region of the inner aspect of both elbow-joints, though it was much less severe than before plasters were applied. This pain was remedied by postural immobilization of the shoulder-joints. After the first change of plaster the pain recurred slightly, but soon disappeared.

Ease of Nursing

Before plasters were applied some cases needed changing of outer dressings at least three times a day because of

the profuse discharge, and there was also the periodical complete changes of dressing in all instances. This was entirely eliminated. The ward sisters repeatedly spoke of the ease with which the necessary attention could be given to these patients, who could now be moved about freely in bed without causing pain. No special instruction, supervision, or apparatus was required in the wards, and it was very apparent that large numbers of burns could easily be handled at one time, even in a busy hospital, without causing any undue strain on the nursing staff.

Improvement in General Condition

With the relief of pain and toxæmia there was in all cases immediate improvement in general condition, appetite, and sleep. That toxæmia was reduced to a minimum was evidenced by the speedy return of pulse and temperature to normal. In 10 cases the temperature ranged between 100° and 102° before plaster application. In 5 cases it became normal in two days; in 3 others normal was reached in three days. Where this was not the case septic burns of other areas not treated in plaster were present, but a rapid improvement was noted.

Flexibility of Joints and Absence of Contracture Formation during Treatment

Certain precautions were taken during treatment. To be assured of the greatest flexibility joint positions were changed at each plaster reapplication; and, to prevent contracture formation, joints were put up in a position that counteracted this possibility.

On admission all cases showed pronounced limitation of movement and the rapid progression of dropped wrists

Table Summarizing the Cases

Case No.	Age	Area of Burns Treated in Plaster	Initial Treatment	*Period after Injury	Mobility of Joints	Days in Plaster	Immediate Result	End Result
1	19	Dorsum of foot, Dorsum and lateral aspect of ankle	Closed plaster	17 hours	Limited owing to pain	14	Completely healed. Ankle movements full	Same
2	33	Feet and ankles. Anterior surface of left leg	Triple dye and AgNO ₃	4 days	Movements painful. Tendency to drop-foot	23	Healed. 5 degrees limitation of dorsiflexion	Full movements in 7 days. Walking normally
3	19	Left foot and ankle	"	4 "	Movements very limited and painful. Tendency to drop-foot	23	Two small granulating spots. 5 degrees limitation of plantar flexion and dorsiflexion	Completely healed. Full movements in 7 days. Walking normally
4	47	Both feet and ankles	"	4 "	Feet dropped. No movements, owing to pain	23	Two small granulating areas. Slight limitation of movements	Completely healed. Full movement in 7 days. Is on exercises and massage for old-standing pes planus
5	37	Left foot	Tannic acid and AgNO ₃	13 "	Foot painful and dropped. Very little movement possible	16	Completely healed. Dorsiflexion 10 degrees. Plantar flexion 15 degrees	Full movements in 10 days
6	27	Right hand and wrist	"	6 "	Completely immobile, owing to tan and pain	10	Completely healed. All movements 70% of normal	" " "
7	25	Both hands and wrists	Vaselined gauze	6 "	Wrists dropped. Fingers immobile	20	Healed except for small granulation on dorsum of right hand	Completely healed. Movements 95% of normal in 10 days
8	26	" "	" "	6 "	Wrists dropped. All joints only slightly mobile, mainly due to pain	10	Completely healed. Movements 70% of normal	Passive movements full. Active movements 95% of normal in 7 days
9	30	" "	" "	6 "	" " "	Rt.—10 Lt.—18	Right, completely healed. Left, all but an area on palmar surface of wrist	Completely healed. Full movements in 10 days
10	25	Dorsum of left hand	Charcoal and AgNO ₃ mixture	11 "	Flexion of m.-p. joints 20 degrees. Finger-joints less limited	16	Completely healed. Joint movements 80% of normal	Full movements in 7 days
11	28	Right hand and wrist	Vaselined gauze	18 "	Very little movement in all joints. Fingers semiflexed, owing to contracture	10	Nearly full extension. Flexion 50% of normal	Finger extension 95% normal. Finger flexion 70% normal. Wrist movements full
12	35	Both hands and wrists	Tannic acid and AgNO ₃	18 "	Very little movement in all joints. Contractures starting	10	Healed except for small granulation on right ring finger	Completely healed. Full movements in 14 days
13	38	Both wrists	" "	18 "	Dorsiflexion nil on both sides	10	Healed. Dorsiflexion 5 degrees. Palmar flexion full	Dorsiflexion full in 10 days
14	40	Right wrist	" "	18 "	Dorsiflexion 5 degrees	10	Healed. Dorsiflexion 15 degrees	Dorsiflexion full in 7 days
15	23	Both upper limbs	Triple dye and AgNO ₃	14 "	Movements of all joints greatly limited	Lt.—10 Rt.—25	Healed except for small granulations. Left elbow 90 degrees of movement. Right elbow 60 degrees of movement	Left limb full movements in 10 days. Right elbow and hand, full movements in 10 days
16	22	" "	Tannic acid and AgNO ₃	21 "	All joints completely immobile. Gross evidence of contractures		Still under treatment	Right limb practically healed. All but forearm on left healed

* Beginning of plaster treatment.

and feet. This was at first considered to be due to muscle spasm; but it was found, when plasters were first applied, that even under anaesthesia there was still definite limitation, although greater range of movements could be obtained. When changing plaster, and after the termination of treatment, flexibility of joints was quite obvious, particularly in hands and fingers, even after long periods of immobilization. Thus in no case did the immobilization result in increased stiffness; in fact, all movements were much better after the period of rest. This was so obvious that some patients remarked that the limb which had been in plaster felt more useful than the corresponding one which had not been so treated.

No contractures developed in patients who received plaster treatment within the first three weeks. In later cases contractures had already started to develop, particularly in areas where there had been full skin loss. In these plaster provided an excellent method of control.

Healing

As previously mentioned, only grossly septic burns were put in plaster, less severe lesions being treated chiefly with vaselined-gauze dressings. When both types existed in the same case it was repeatedly observed that the severe lesions healed as quickly as the much less severe ones not treated in plaster.

The rate of healing varied with the severity and extent of the burnt area, the degree of sepsis, and the interval between injury and the beginning of plaster treatment. Eight burns of the hands and fingers extending on to the wrists and forearms healed in ten days, except for an area of granulation tissue on the palmar surface of a wrist in one case. This healed in a further eight days in plaster that immobilized the wrist-joint only. Two other hands and fingers with burns and sepsis of greater severity healed in eighteen days. In these, at the time of plaster change, areas of granulation tissue were present on the dorsum of the hands and palmar surfaces of the wrists, involving one-quarter to one-third of those surfaces. Burns of the wrists healed in ten days. All feet and ankles healed in twenty-three days, and showed large areas of granulation tissue when the plaster was changed. In all cases in which granulation tissue was present the ingrowing epithelium did not reveal any signs of limitation, as is seen definitely during other methods of treatment. In most it appeared to be invading the granulation tissue in an irregular protrusive manner, and later these same areas showed epithelization that was complete except for occasional very small granulations which healed in two to three days after application of silver nitrate. This new epithelium was well formed, smooth, and pliable, and there was very little evidence of scarring even over areas which had been granulating. Hypersensitivity of this epithelium was less than in cases not treated in plaster.

In one case of burns involving the whole of both upper extremities plaster treatment was begun three weeks after injury. The right limb showed numerous areas of granulation tissue varying in size from one to three inches in diameter at the first plaster change, and was practically healed in twenty days. The left limb showed clean granulation tissue involving the whole forearm and lower part of the arm at the first change of plaster. At the end of twenty days only three-quarters of the forearm was involved, and it was considered advisable, because of the lateness of starting treatment, to "seed"-graft this area and reapply plaster in an effort to speed up epithelization.

Return of Function

This also varied with the severity and extent of the burnt area and the degree of sepsis, but especially with the

interval between injury and application of the closed-plaster treatment. In cases which were received within one week of initial treatment function that was nearly normal was obtained in seven days and full function shortly after. In cases received later than this return to full function was slower.

Summary

A description is given of a series of 16 cases of infected burns of the extremities in which closed-plaster treatment was used.

The difficulty in assessing the degree of burn in infected cases is commented on.

Details of technique are described.

Certain definite advantages of the method are claimed—namely, freedom from pain, rapid improvement in general condition as evidenced by fall in pulse and temperature, ease of nursing (important where large numbers have to be dealt with), maintenance of joint flexibility, and prevention and correction of contractures.

The results in this series are such as strongly to suggest that epithelization and return of function are quicker than in cases treated by other methods.

My thanks are due to Lieut.-Colonel G. M. Millar for his co-operation and for permission to publish these cases.

Medical Memoranda

Crohn's Disease with Acute Obstruction

The following case is placed on record because of its uncommon nature.

CASE REPORT

The patient, a soldier aged 27, gave a history of vague attacks of umbilical pain of increasing frequency and severity over a period of three years. These attacks occurred every few months and lasted from one to two days. He never vomited and he had no other symptoms. Two years previously he had sought medical advice, but radiological examination of the gastrointestinal tract was negative. No cause for his symptoms was found at that time, and when he entered the Army a year later he appeared to be quite fit.

While in barracks in February, 1941, he developed pain similar to his previous attacks and was admitted to our care, with the diagnosis of recurrent appendicitis. When seen by us he had had severe umbilical colic intermittently for six hours, and had vomited once. His temperature was 99°, pulse 110, and respirations 24. On examination the tongue was coated and the breath offensive. There was no abdominal pain or rigidity between spasms, but he complained of soreness on pressure of any part of his abdominal wall during a pain. This was no worse at any one point than another. On rectal examination nothing was found. A blood count showed 15,650 leucocytes per c.mm., with a predominance of polymorphonuclear cells.

Acute appendicitis seemed to be the most likely diagnosis, but as this was by no means certain the abdomen was opened through a right lower paramedian incision. The peritoneal cavity contained a considerable amount of cloudy fluid. About six inches of the lower ileum was acutely inflamed and thickened; the bowel above this portion was dilated and that below collapsed. One foot of bowel was resected, a side-to-side anastomosis made, and the abdomen closed. The patient made an uneventful recovery.

Examination of the specimen showed an inflamed piece of small intestine, with partial obstruction due to thickening of the wall and reduction of the lumen for approximately two inches. Above this the muscle wall was hypertrophied. The obstruction was completed by a pea in a small pouch immediately above the narrow portion, otherwise the lumen was patent. The mucous membrane was covered by rather ragged ulcers, and the muscular wall was thickened, hard, and rather translucent. Microscopically there was an extensive old fibrosing granulomatous lesion. A few recent typical tubercle follicles were seen in the lymphatics deep to the muscular wall, but no tubercle bacilli were detected.