

THE TREATMENT AND PROPHYLAXIS OF SUPERFICIAL RINGWORM INFECTIONS.

BY SURGEON LIEUTENANT-COMMANDER P. K. FRASER, M.D.
Royal Navy.

[In submitting this article for publication in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS I should like it to be taken as an expression of my thanks to the officers and men of the R.A.M.C. who have so kindly helped with the investigation during the last five years. The subject of the paper has already been admirably dealt with in the Journal, but I hope that some of the points raised may be of interest.]

At some time or other since the discovery of mycotic skin lesions, practically every antiseptic has been lauded as a specific cure. This at first glance tends to demonstrate the inefficacy of all; on the other hand, it may also show that any logical treatment under careful and experienced supervision will be successful. Too many practitioners regard the common pathogenic fungi as indestructible, a state of affairs which is not borne out in the laboratory, and this despairing attitude is evident in the casualness of their treatment. It is also not uncommon to find illogical combinations of treatment in the same patient. This is bad policy, and is undoubtedly one of the best methods of producing dermatitis venenata. As in all branches of medicine, it is much better to adhere to a few proved remedies than to rush blindly from one new discovery to another.

Superficial ringworm infections can be permanently cured, provided the disease is regarded as a whole and not as a localized skin infection. It is not enough to eradicate the parasite in the infected area; infected clothes must also be dealt with and, if possible, the source of infection traced. The difficulties in the latter method of approach were pointed out by Weidman (1934) when he said:—

“The hygiene of the problem is so complicated that I doubt whether the difficulty can be met by that route. It is impossible to sterilize all the wearing apparel of the patient; even so, there would still remain the floor coverings in our homes, hotels, shower baths, etc. It seems to me that the real approach to the millennium in the way of treatment is to establish conditions in the intertriginous locations in which the fungi work and mobilize, which will make these locations undesirable to the fungus.”

In some cases it will be impossible to sterilize all the clothes, but it is essential to eradicate the fungus in garments in direct contact with the infected area. In the case of pedal infections it will be necessary, subsequent to treatment, to acidify the interdigital spaces as a prophylactic against reinfection.

COMMON THERAPEUTIC AGENTS.

Iodine.—Of the various medicaments in common use iodine holds pride of place, and its efficacy has been proved *in vivo* and *in vitro*. It is especially useful in tinea cruris and can be applied as the strong or weak tincture or potentiated with potassium iodide as suggested by Strickler (1933). The French use intravenous solutions of iodine, and they recommend them in this way for tinea barbæ and other deep-seated infections (Roxburgh, 1937).

℞	Iodine crystals	..	..	2 parts
	Potas. iodide	..	..	3 "
	Aqua destil	..	ad	100 "

Commence with 1 c.c. in 5 c.c. distilled water and increase by 1 c.c. daily until 5 c.c. are injected in 15 c.c. distilled water. Swartz (1935) reports good results from ethyl iodide inhalations.

There is usually some irritation when iodine is applied to the crural region, and if this is not carefully watched an irritant dermatitis may be set up. I have a personal aversion to iodine in any form, and I have seen a great many bad results from over-treatment.

Salicylic Acid.—This acid is universally used in mycotic infections, and it is usually combined with benzoic acid as in Whitfield's ointment:—

℞	Ac. salicyl.	..	..	15 gr.
	Ac. benzoic	..	..	25 gr.
	Paraf. mol.	..	..	2 dr.
	Ol. cocois. nucis.	..	ad	1 oz.

The ointment is extremely fluid in hot weather and 15 grains of hard paraffin can be added as a stiffening agent. It is somewhat irritating when used near the scrotum, and Whitfield (1934) recommends that it should be used for five days at a time with rest periods of three days. It has the advantage of being colourless. If a paint is preferred the following is useful:—

℞	Ac. salicyl.	..	..	1 dr.
	Ac. benzoic.	..	..	1½ oz.
	Acetone	..	..	1 oz.
	Sp. vini meth.	..	ad	4 oz.

The above combinations of salicylic acid sometimes yield disappointing results, and Whitfield says that some of the claims as to their usefulness are extravagant. I always add 1·4 per cent thymol to Whitfield's ointment as suggested by Legge *et al.* (1934). This of course precludes its use round the anus. Parke, Davis and Co. market a salicylic ointment and paint under the name of "Mycozol." An iodide salicylic acid paint has been advocated by Strickler—

℞	Iodine crystals	..	..	1·3 parts
	Potas. iodide	..	..	1·9 "
	Ac. salicyl.	..	..	1·9 "
	Ac. boric	..	..	3·8 "
	Alcohol 50 per cent	..	ad	59·1 "

and the originator claims a very low percentage of irritant reactions.

The use of macerating ointments in interdigital pedal infections necessitates frequent curettage, and this should always be done personally. Such a procedure removes dead skin and thoroughly exposes the infected area. It is also desirable, no matter what routine is adopted, to supervise every step in the treatment personally. The results from such personal treatment are much more satisfactory.

In the somewhat rare mycotic pruritis ani, Castellani (1924) recommends a combined salicylic ointment as originated by Deek :—

℞	Ac. salicyl.	..	..	..	4 parts
	Bismuth subnit.	..	..	..	10 „
	Mercury salicyl.	..	..	..	4 „
	Ol. eucalypti.	..	..	..	10 „
	Paraf. liq.	}	..	..	āā 100 „
	Adeps lani				

From a single personal experience I can best describe this preparation as “very stimulating.”

Chrysarobin.—In the course of years chrysarobin has been found to be almost a specific in the treatment of superficial mycotic infections. Indeed it was for the treatment of these conditions that it was first introduced (Norman Walker, 1932). Employed as an ointment—

℞	Chrysarobin	..	..	..	20 gr.
	Adeps lani	}	..	..	āā 4 dr.
	Paraf. mol.				

it is specific for tinea cruris. Inunction should be carried out once a day for four to seven days, according to the reaction of the patient. Some will complain of slight burning from this treatment, but it is surprising how few side effects are produced. It should be followed by a soothing lotion, such as lotio calaminæ, to which half a drachm of liquor picis carbonis or 3 per cent ichthyol can be added.

A synthetic derivative of chrysarobin—cignolin, prepared by Bayer, is extremely useful in tinea pedis. In ointment form—

℞	Cignolin	..	..	..	10 gr.
	Adeps lani	}	..	..	āā 4 dr.
	Paraf. mol.				

it should be rubbed into the infected area once daily, taking care that the interdigital spaces are also treated. This treatment can be given to cases of vesicular tinea, and I have even applied it to the weeping eczematoid type with success. Seven to fourteen days of daily applications will effect a cure. After inunction the parts should be wrapped in gauze, and the patient should wear loose-fitting shoes or sandals. It may even be necessary to put him to bed in the later stages of the treatment. Cignolin can be applied to the crural type of tinea, but there is usually considerable discomfort from this measure.

When using chrysarobin and its derivatives, the irritant effect on the

eyes should be remembered, in addition to their ability to "turn fine linen into purple raiment."

Burgess (1938) recommends a chrysarobin ointment with salicylic acid (Dreuw's ointment) :—

R̄	Ac. salicyl.	..	..	..	6 parts
	Chrysarobin	..	..	..	12 "
	Ol. rusci	..	..	..	12 "
	Lin. sap. mol.	..	..	..	15 "
	Paraf. mol.	..	..	..	60 "

Chrysarobin and cignolin do not act well in paint form.

Dyes.—Fuchsin is undoubtedly one of the best antimycotic dyes and it is most commonly employed in the paint form originated by Castellani (1929) :—

R̄	Sat. alcoholic soln. basic-fuchsin	10 c.c.
	5 per cent aq. carbolic acid soln.	100 c.c.
	Filter and add—	
	Boric acid	1 gm.
	After two hours add—	
	Acetone	5 c.c.
	Two hours later add—	
	Resorcin	10 gm.
	Store in a dark coloured bottle.	

It is a non-irritant preparation and is specific for tinea cruris and corporis. The only drawbacks are its colour and staining properties. Daily application for seven to fourteen days will effect a cure and the method is of importance in the treatment of mycotic infections in women. When applied to the feet it may cause drying and fissuring and it may have to be alternated with an ointment. The results in pedal tinea are somewhat disappointing.

Two-per-cent malachite green in spirit is another useful preparation. It has much the same properties as fuchsin paint and is used in the same way for similar conditions.

Industrial Fungicides.—Abracide in the form of an emulsion with soap is extremely popular in some quarters. It is usually employed as a 1:100 bath. In dilutions above this the abracide comes out of solution and floats to the surface. In a series of tests conducted by myself it was found that with the 1:100 solution there was considerable irritation, and that in strengths below this the irritation was confined to the junction of the part under treatment with the surface of the lotion. A 1:100 bath has been advocated as a prophylactic, but this is uneconomic and dangerous.

Paranitrophenol as used in the leather trade is completely non-irritating. Used in a 2 per cent aqueous solution twenty minutes daily for a week, it is of value in tinea pedis and manis. The objectionable yellow colour can be obviated by adding a few drops of hydrochloric acid. On account of the drying effect it should be followed by an ointment. Some workers prefer a 2 per cent solution in spirit.

Mycoten is a favourite remedy in Denmark, and Lomholt (Goldsmith, (1936)) advises the following combination :—

℞	Mycoten	}	..	āā	3 parts
	Ac. salicyl.				
	Paraf. liq.				
	Ung. plumbi ox. (D.P.)		..	60	„

It is frequently employed with a mycoeten paint.

Metallic Fungicides.—Copper salts in high dilution are lethal to the lower forms of vegetable life, and their use has been logically recommended in mycotic dermatoses. Moloney (1937) reports good results from a 20 per cent solution of dehydrated copper sulphate in pure glycerine. It should be rubbed into the lesion daily for fifteen minutes. Weak solutions of silver nitrate are also useful in the weeping eczematoid type.

Mycotic Extracts.—A considerable amount of work has been done on the use of mycotic extracts in ringworm infections, and the results have been universally disappointing. Even in cases with manifest allergic eruptions it is sufficient to treat the primary lesion. Recently Tolmach and Traub (1938) carried out a carefully controlled series of tests with poor results. In the present state of our knowledge these preparations cannot be recommended for general treatment.

Powders.—Powders are useful in treatment as an adjuvant to ointments. In weeping cases they cause drying of the discharge, and frequently they are all that is required to effect a cure. Burgess recommends :—

℞	Boric acid	}	..	āā	1 part
	Venetian talc.				
	Kaolin				

Silantox (amorphous silicon dioxide, Silica Gel, Ltd.) is another useful dusting powder. It is best to exclude starch from all powders to be used on the feet. In the presence of moisture and movement it tends to cake and may aggravate itching. As a rule 2 per cent salicylic acid is added to the above preparations. Holmes (1939) claims good results from the following powder which is much used in the U.S. Navy :—

℞	Salicylic acid	..	..	5	parts
	Menthol	..	..	2	„
	Camphor	..	..	8	„
	Boric acid	..	..	50	„
	Starch	..	..	35	„

If should be rubbed into the affected parts three times a day, but is contra-indicated in the weeping eczematoid type.

Sterilization of Cloths.—Whenever possible all garments in contact with the infected area should be boiled. This will include socks, singlets, etc. In the case of boots or leather gloves, they should be placed in a box with 50 c.c. of formalin in an open container and left for twenty-four hours. To save time, the insides of shoes can be swabbed with formalin and left to

air for two days. Insoles should be destroyed and replaced by new ones. It may be mentioned that many of the agents employed in dry cleaning are not fungicidal. Kadisch (1931) advises 1 per cent thymol in spirit for sterilizing clothes, but the method seems unduly expensive. Steam sterilization is satisfactory. Recently a modification of this method has been produced which uses formalin vapour in a partial vacuum and would seem to be ideal.

TREATMENT OF TINEA CRURIS.

If the affected area is inflamed or weeping, calamine lotion, or ichthyol calamine lotion, should be applied three times a day. Some prefer to use ung. hydrarg. ammon. at the start. Undergarments should be sterilized at the commencement of treatment and regularly thereafter. When the inflammation has subsided, one of the ointments or paints should then be used daily, or twice daily, according to the reaction of the individual. Later, when a cure has been effected, the area should be dusted frequently with a salicylic acid powder.

This routine is also sufficient for tinea axillaris.

TREATMENT OF TINEA PEDIS.

It is essential in all cases of foot infection to ensure adequate ventilation. Woollen socks should be prohibited (Berberian, 1938), and cotton or "cellular" socks worn instead. Rubber shoes are bad as they increase local temperature and humidity, and sandals or shoes with open uppers should be used.

In the presence of a superadded pustular infection, 1 : 4,000 potassium permanganate solution, or 1 : 5,000 perchloride of mercury solution, should be used as a bath twice daily, and the feet should be powdered between treatments. When the eczematoid element has been cured, an ointment should be rubbed in. The number of inunctions per day will again depend on the individual reaction. Castellani's paint has a justly deserved reputation in eczematoid ringworms, but it usually requires to be supplemented by an ointment when the case has reached the dry stage.

With salicylic ointments interdigital curettage should be done once weekly and the socks should be boiled frequently. Pedal hyperidrosis, if present, must be treated, and the following will be found effective : Equal parts spirit vini meth. and water morning and night, or a foot bath of 5 per cent formalin once daily for ten minutes.

Subsequent to cure, regular prophylactic measures, as detailed later, should be carried out.

TREATMENT OF TINEA UNGUIUM.

As the primary focus is in the nail bed, the difficulties in the treatment of nail infections can be appreciated. Undoubtedly the best method is to

avulse the nail under local or general anæsthesia and apply antimycotic agents to the bed. In most cases this will suffice, but occasionally it will be necessary to destroy the nail permanently. A more tedious method is to apply liquor potassæ and scrape away the softened layer. Whitfield (1934) advises an ointment of 12 per cent benzoic acid and 6 per cent salicylic acid. This should be strapped over the infected parts daily. The nails will come off in about three weeks and as a rule no further treatment is required. Fehling's solution as a daily dressing on lint is useful, and evaporation can be prevented by the use of rubber finger-stalls.

Local applications are extremely painful and it may be necessary to use sedative drugs during their use.

PROPHYLAXIS.

Prophylactic measures are of two kinds: those directed towards the individual, and those directed towards his surroundings. Of these the former is to be preferred, as the responsibility is thus placed on the individual. General measures such as interceptor baths, etc., are unsatisfactory by themselves.

Personal.—Firstly, education on foot hygiene is essential. It is astonishing the number of otherwise cleanly people who do not wash the interdigital spaces when bathing, and an equally large number do not bother to dry them properly. This, I consider, is the basis of most pedal mycoses. The natural warmth of the foot and retained moisture predispose to maceration and the soil is thus prepared for infection. In his investigation on U.S. soldiers, Wilson (1934) found that the largest company had the lowest incidence of foot complaints, due to the fact that the company commander took a keen interest in the welfare of his men. By frequent personal examinations of their feet he produced a most salutary "foot fixation" complex in his command.

The feet should be kept from contact with the bathroom floor as much as possible and paper slippers, such as are used in America, are useful.

I am convinced that the danger period occurs between washing the feet and drying them. An analogy with usual practice would be to wash the hands and rub them on the floor before drying. It is no exaggeration to say that in the height of the summer most common bathroom and bathing establishment floors will grow orchids, to say nothing of a simple organisation like a pathogenic fungus.

Notices should be placed in all washing places and showers. To be effective, such notices should be concise, and the following is suggested as satisfactory:—

YOUR FEET.

"Carelessness in washing and drying the feet will lead to eczema and ringworm.

Wash carefully between your toes and powder them after drying.
Report to the doctor at the first sign of trouble."

The feet and interdigital spaces should be washed with soap and water at least once a day, and finally rinsed with cold water to inhibit sweating. They should then be thoroughly dried and powdered with salicylic acid talc, or rubbed with lemon juice as advised by Belisario (1936). Osborne (Goldsmith, 1936) favours swabbing the toes with 1 per cent sodium hypochlorite solution, but this seems unnecessary in the face of more simple measures. In hot countries "cellular" socks and "ventilated" shoes should be worn at all times. Frequently cramping of the feet is due to shrunken socks and not, as is usually supposed, to ill-fitting shoes.

Cross-infection by towels can be prevented by impressing on the individual the necessity for using only his own towel. In humid countries, facilities for drying towels after bathing should be provided.

General.—As bathroom floors are generally suspect, they should be washed frequently with soap and water. Forced ventilation may be necessary to ensure thorough drying. Wooden floors and mats which cannot be properly cleaned should be dispensed with, and tiles or polished concrete substituted. Rubber mats are excellent as they are easily cleaned. Bath stools and benches should be abolished and drying should be done while standing in the bath or shower cubicle. Traffic in the bathroom should be reduced to a minimum.

In the presence of overt infection walls and floors should be swabbed after washing with 2 per cent sodium hypochlorite solution. Formalin is useful, but the room cannot be used for some time afterwards. A shallow rubber bath containing a solution of 1 per cent sodium hypochlorite may be placed at the entrance to the wash place and bathers made to pass through it. The solution should be changed daily. Acidulated 0.5 per cent parani-trophenol solution is efficacious, but unless the feet are rinsed before drying the yellow colour reappears on towels. Sodium thiosulphate does not appear to be satisfactory. Copper salts have not been used in prophylaxis and investigations as to their efficacy would be extremely interesting.

Perhaps the best and simplest method is to sprinkle chloride of lime powder, such as is used for water purification, on the bathroom floor. This soon becomes converted into an adhesive, strongly antiseptic, and altogether objectionable mush, and forces the individual to wash and dry his feet carefully. The subsequent washing greatly lessens the risk of chemical dermatitis. It is also advisable to provide large dredgers of salicylic acid talc or other foot powder.

COMMENTARY.

In this article no hard and fast routine for treatment has been laid down as I consider that any logical method in careful hands and under personal supervision will be successful. It must be remembered, however, that ringworm infections are caused by a vegetable parasite which can remain viable for considerable periods, and it will be necessary to eradicate

possible sources of reinfection in the patient's clothes, shoes, etc., before a case can be pronounced "fungus-free."

No mention has been made of X-rays in treatment. Undoubtedly excellent results have been obtained, especially in chronic pedal cases, but the method is too dangerous to be generally adopted.

REFERENCES.

- BELISARIO, J. C. (1936). *Brit. Med. J.*, **1**, 405.
 BERBERIAN, D. A. (1938). *Arch. Derm. Syph.*, Chicago, **38**, 367.
 BURGESS, J. F. (1938). *Canad. Med. Assoc. J.*, **38**, 577.
 CASTELLANI, A. (1924). *J. Trop. Med. Hyg.*, **27**, 304.
Idem. (1929). *Ibid.*, **32**, 77.
 GOLDSMITH, N. (1936). "Recent Advances in Dermatology," Churchill, p. 363.
 HOLMES, J. G. (1939). *J.R. Nav. Med. Serv.*, **25**, 177.
 KADISCH, E. (1931). *Dermat. Wschr.*, **37**, 1433.
 LEGGE, R. T., *et al.* (1934). *Arch. Derm. Syph.*, Chicago, **29**, 521.
 MOLONEY, J. B. (1937). *U.S. Navy Med. Bull.*, **35**, 440.
 OSBORNE. Quoted by GOLDSMITH, N. (*vide supra*).
 ROXBURGH, A. C. (1937). "Common Skin Diseases," Churchill, p. 142.
 STRICKLER, A. (1933). *Arch. Derm. Syph.*, Chicago, **28**, 836.
 SWARTZ, J. H. (1935). *Ibid.*, **32**, 551.
 TOLMACH, J. A., and TRAUB, E. F. (1938). *Ibid.*, **38**, 925.
 WALKER, N. (1932). "Introduction to Dermatology," W. Green and Son, p. 243.
 WEIDMAN, F. D. Quoted GRAY, A. M. H. (1934). *Brit. Med. J.*, **2**, 541.
 WHITFIELD, A. (1934). *J. Trop. Med. Hyg.*, **37**, 353.
 WILSON, D. J. (1934). *Arch. Derm. Syph.*, Chicago, **30**, 841.