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THE EFFECTS OF POLYTHENE OCCLUSION AND TOPICAL CORTICOSTEROIDS ON RESISTANCE TO FRICTION INJURY IN THE SKIN

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Abstract. Application of a non-aqueous cream base under polythene occlusion greatly increased the coefficient of friction of forearm skin and decreased its resistance to friction trauma. Incorporation of a fluorinated corticosteroid only partially restored these changes to normal.

The effects of corticosteroids on collagen and dermal ground substance have been extensively investigated but little has been done to clarify their effect on epidermal structure and function. Since topical application of corticosteroids to the epidermis is practised extensively, this would seem to be a significant gap in our knowledge of their action in dermatological conditions. It was therefore decided to study the effect of corticosteroids on a basic property of the epidermis, viz. its friction coefficient and its resistance to friction trauma. Since occlusion under polythene is a technique often combined with topical corticosteroid application, the effect of this on the skin's resistance to friction trauma was also studied.

MATERIAL AND METHODS

Details of the friction-producing machine and its operation have been published elsewhere (1).

The subjects were the research team (J. S. C., E. B., J. S., and C. B.), volunteers from the medical staff, medical students and certain patients who suffered from various skin diseases and to whom the nature and purpose of the experiment were explained. In general, these were patients who suffered from skin diseases where we had reason to believe information about the resistance of their skin to friction trauma might be relevant to further understanding of their disease process, viz. the bullous dermatoses, epidermolysis bullosa, porphyria.

Observation of μ_k and the time taken to produce erosions were made at varying intervals after treatment with 0.025% fluclorolone acetonide (Topilar) in a non-aqueous cream base under polythene occlusion; the volar aspect of the forearm was used and control observations were made on skin treated with the cream base, usually on a symmetrical site on the opposite arm.

RESULTS (Tables I and II)

The occlusion with polythene and the cream base has itself considerably increased the friction of the skin surface above the normal for this site ($t = 4.83$, $p < 0.001$) and there is a consequent significant reduction in the mean erosion time ($t = 3.19$, $p < 0.005$). The fluorinated corticosteroid fluclorolone, similarly applied under a polythene occlusive dressing in the same base, for periods ranging from 70 minutes to 24 hours, produces a significant prolongation of erosion time ($t = 4.62$, $p < 0.01$) but this reversion towards normality is incomplete by a large margin.

DISCUSSION

The alterations in surface friction (μ_k) are quite sufficient to account for the decrease in erosion times observed in the treated forearms since it has been shown that these quantities obey a relationship of the form $N\alpha \frac{1}{\mu_k^3}$ where N = number of strokes to erosion (2). The great increase in the coefficient of friction of occluded skin is likely to be due to the increased hydration of stratum corneum which this manoeuvre produces, as simple hydration alone may increase μ_k as much as five-fold (3). These observations clearly have a direct bearing on present dermatological practice which uses the technique of polythene occlusion widely in a variety of skin diseases. It could well be that the beneficial effects of the active medicament in some cases are vitiated by

Table I. *Time (in minutes) to produce erosions on skin treated with a corticosteroid cream (Topilar)*

Control side (polythene + base)		Test side (polythene − base + corticosteroid)		
Erosion time (min)	μ_k	Erosion time (min)	μ_k	Technique (in vivo)
2.0	1.13	3.0	0.99	Applied without occlusion for 70 min
2.0	n.d.	4.1	n.d.	Occlusion under polythene for 1.5 h
2.2	0.76	2.2	0.81	4 h
1.7	1.02	4.5	0.69	4 h
5.5	0.51	8.0	0.60	10.5 h
2.8	1.26	3.5	0.87	10.5 h
6.0	0.34	7.0	0.42	18 h
1.6	1.29	4.7	1.01	24 h
2.7	0.83	4.1	0.64	24 h
Mean ± S.D.	2.95 ± 1.64	0.89 ± 0.35	4.58 ± 1.85	0.76 ± 0.20

Table II. *Erosion time and friction coefficient in 22 untreated normal controls*

Erosion time ± S.D. (min)	μ_k ± S.D.
12.7 ± 8.9	0.48 ± 0.14

the damaging results of occlusion on the skin's resistance to trauma. This might be particularly important in states where the physical integrity of the skin is already jeopardised, e.g. in eczema, pemphigus and epidermolysis bullosa.

It is noteworthy that the protective effects of a powerful fluorinated corticosteroid, although significant, only partially restore the skin's resistance to normality. The mechanism of this beneficial action is unknown but stabilisation of lysosomal enzymes is a possibility; alternatively it might affect the degree of hydration of the superficial epidermal layers, perhaps by inhibiting sweat delivery to the surface, as with glutaraldehyde.

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