Occlusive therapy in dermatology

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Introduction

Occlusion refers to skin being covered directly or indirectly by impermeable films or substances such as diapers, tape, chambers, gloves, textiles, garments, wound dressings, transdermal devices, etc. Certain topical vehicles that contain fats and polymers oils (petrolatum, paraffin, etc.) may also generate occlusive effects.[1]

The effects of occlusion on the skin are complex and may produce profound changes including altering epidermal lipids, DNA synthesis, epidermal turnover, pH, epidermal morphology, sweat glands, Langerhans cells stresses, and many more, which are tabulated in Table 1.[2,3]

Hydration of the skin is often achieved through occlusion, which increases the penetration of topical medications in clinical practice. Occlusion does not lead to an increase in percutaneous absorption of all chemicals. It has less impact on polar compounds but may boost the penetration of lipid-soluble, non-polar molecules. Increasing penetrant lipophilicity enhances occlusion-induced absorption. The degree of penetration enhancement provided by occlusion is compound-specific and may be influenced by temperature, humidity, and occlusion methods. Drug absorption is influenced by several variables, including the anatomical site, physiochemical properties of the drug, and the vehicle in which the drug is produced, which in one way has to pass through the skin barrier.

Table 1: Effect of occlusion on skin

SI. No	Changes in skin on occlusion
1.	pH becomes more basic.
2.	Trans-epidermal water loss is increased.
3.	Carbon dioxide emission is increased.
4.	Relative skin moisture content is increased.
5.	Increase skin surface temperature.
6.	After 3–6 hours, the intercellular spaces in the basal layer widen with perinuclear vacuolisation of the keratinocytes.
7.	Change in appearance of langerhans cells after occlusion with fewer organelles, more electron-dense cytoplasm, and increased concentration of filaments
8.	Time-dependent change with increased size of intracellular spaces in the basal layer and invasion of mononuclear cells
9.	The density of bacterial colonisation increased 4 orders of magnitude after 48 hours of uninterrupted occlusion.
10.	During occlusion, coagulate-negative staphylococci remained the predominant bacterial isolate.

Stratum corneum has been well recognised as the principal barrier of the skin. It is a cellular tissue, a fabric of cornified cells, creating a tough, flexible, coherent membrane that acts as a two-way barrier by minimising the loss of water, electrolytes, and other body constituents and decreasing the entry of noxious substances from the external environment.[4]

For the barrier to work properly, the structural integrity of the stratum corneum must be maintained. The effectiveness of the barrier can be gradually decreased by increasing stratum corneum hydration. When submerged in water, stratum corneum can pick up 500% of its dry weight in less than an hour and expand vertically to four to five times its original breadth. Stimulation of DNA synthesis leading to epidermal hyperplasia may be a second mechanism by which the epidermis repairs defects in the barrier function.

The transepidermal route involves transfer via the intercellular gaps and the intracellular or transcellular route through the cells between the skin's appendages. Water content can be increased up to 50% with occlusion: even a short time (30 min) exposure can result in significantly

How to cite this article: Dhanani S, Shah M, Nair P. Occlusive therapy in dermatology. Indian J Dermatol Venereol Leprol. 2025;91:132-5. doi: 10.25259/IJDVL_615_2023

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Received: June, 2023 **Accepted:** August, 2023 **EPub Ahead of Print:** June, 2024 **Published:** December, 2024

DOI: 10.25259/IJDVL_615_2023 **PMID:** 39152885

increased stratum corneum hydration.[4] With 24-hour occlusion, the relative water content in the stratum corneum can be increased significantly from 53% without occlusion to 59% with occlusion. Water under occlusion may disrupt barrier lipids and damage the stratum corneum in a way like surfactants.

Occlusion may enhance the penetration of most lipophilic compounds but often fails to increase the penetration of relatively hydrophilic compounds. Initially, a drug enters the stratum corneum under occlusive conditions. After dressing removal and stratum corneum dehydration, the movement of the drug slows down, and the stratum corneum becomes a reservoir. Occlusion alters many factors that may influence percutaneous absorption:[5]

- Altering the partitioning between the surface chemical and the skin due to the increasing presence of water content in stratum corneum from a normal range of 10–20% up to 50 percent.
- Swelling the corneocytes and possibly altering the intercellular lipid phase organisation.
- Increasing the skin surface temperature from a normal range.
- Increasing blood flow.
- Preventing the applied compound's accidental wiping or evaporation (volatile compound) maintains a higher applied dose.
- Serving as a reservoir of the drug for penetration due to hydration.

Types of occlusive dressings - Types of occlusive materials used as dressing for dermatological conditions are tabulated in Table 2.

One method that can be used for occlusion with various dressings for different diseases is - Unna boot. Unna boot is a compressive semi-solid gauze casting saturated with zinc oxide, gum acacia, glycerol, castor oil, and deionised water.[6] It is an inexpensive and noninvasive treatment strategy in which compression, antioxidants, physical restraint, and improved topical medication absorption enhance healing and quality of life.

Table 2: Types of occlusive dressings[5]

SI. No	Types	Features	Disadvantage
1.	Semi-permeable films	Impermeable to bacteria and liquid but permeable to moisture vapour and air	Exudates may accumulate underneath.
2.	Hydrogels	It has 96% water but doesn't dissolve in water and causes swelling if exposed to liquid.	Dries quickly, thus reduced effectiveness and frequent changing.
3.	Hydrocolloids	Impermeable to gases and moisture vapour, permeable to water vapour, and absorbs wound exudates	Gel and smell phenomenon- forms odorous residue when mixed with exudates
4.	Alginates	Hemostatic property Gel formation- helps in reducing pain during removal	Requires secondary dressing to be attached

Table 3: Occlusion therapy used in dermatology

1. Atopic dermatitis	11. Basal cell carcinoma
2. Psoriasis **(Ub)**	12. Plantar fissures
3. Eczema **(Ub)**	13. Actinic keratosis **(Ub)**
4. Allergic dermatitis	14. Lichen simplex sclerosus **(Ub)**
5. Warts	15. Bullous lymphedema **(Ub)**
6. Erythroderma	16. Eruptive Keratoacanthoma **(Ub)**
7. Keloid and hypertrophic scar	17. Lipodermatosclerosis **(Ub)**
8. Diffuse palmoplantar keratoderma	18. Venous stasis Dermatitis and Venous ulcer **(Ub)**
9. Necrobiosis lipoidica	19. Onychomycosis
10. Squamous cell carcinoma	

Ub: Unna boot.

Indications of occlusive therapy- Dermatological diseases where occlusion therapy is useful include: [Table 3]

1. Atopic dermatitis- Occlusive therapy, including both dry and wet (wet-wrap therapy'), offers a treatment option for atopic dermatitis (AD), which may be underutilised in clinical practice due to concerns about burdensome regimens and potential complications.
   - Wet wrap therapy (WWT) includes the application of topical steroids followed by two-layer bandages, one with a moist bandage previously coated with a topical agent and a second dry bandage. It is commonly used in moderate to severe atopic dermatitis. This helps in an acute inflammatory stage in rapid healing.[7]
   - Dry wrap therapy has bandaging with a dry bandage but is less commonly used.
   - Wet-wrap dressings with diluted topical corticosteroids are a more efficacious short-term intervention treatment in children with severe and refractory AD than wet-wrap dressings with emollients.
2. Psoriasis-
   - The combination of fluocinonide ointment and occlusion produced significantly more improvement than either treatment alone. The keratinocyte mitotic index was most significantly reduced by corticoid tape, then anthralin, and finally occlusion. Flurandrenolide tape significantly lowered the mitotic index compared to treatment with plastic tape occlusion or anthralin, and all treatments significantly reduced the mitotic index compared to untreated plaque.[3]
   - Calcipotriol ointment with occlusion is effective as increased pH in occluded skin may prolong the activity of the calcipotriene molecule, which is known to be fragile in acidic environments.
   - Various studies have shown the relative advantage of hydrocolloid dressings in patients with

psoriasis as treated plaques resolved with 10 weekly applications of hydrocolloid dressing. The dressing was superior to twice daily application of potent topical steroid cream for 10 weeks.[8]

Some side effects particularly seen are-

- Koebner phenomenon from the tape-stripping-like effect of dressing removal leading to worsening of plaques
- Auspitz sign after removal of the dressing on plaques
- Hyperpigmentation

3. Eczemas- Potent topical steroids form an effective treatment and are more efficacious when occlusion is used. Thus, it forms an integral part of recalcitrant eczemas/dermatitis treatment.
4. Molluscum Contagiosum- Occlusion therapy with hydrogen peroxide 1 % cream was used and the exposure of the virus to the drug was found to be increased, leading to improved treatment results with a shorter application period.[9]
5. Erythroderma- The application of medium-strength corticosteroid after soaking in and occlusion under a sauna suit is quite effective. Moist pajamas can be added under the sauna suit as an occlusion.[10] The use of class 1 glucocorticoids under occlusion twice daily for short periods for the rapid control of erythrodermic psoriasis deserves further investigation and, potentially, may decrease the length of hospitalisation and increase the rate of clearing in such patients.
6. Diffuse palmoplantar keratodermas- May be poorly responsive to therapy such as 5 % salicylic acid, urea, etc. 50 % propylene underwater occlusion may help treat the hyperkeratosis.
7. Necrobiosis lipoidica- After the control of diabetes is achieved, initial therapy can be started as super-potent topical corticosteroids with occlusion. Topical calcineurin inhibitors can also be given. If a large ulcer is formed, regular dressing forms the mainstay of treatment.[11]
8. Keloid and Hypertrophic scar- The silicone gel treatment with occlusive dressing modulates the expression of growth factors, including fibroblast growth factor beta that stimulates collagen synthesis. It can be carried out easily and has shown improvement.[12]
9. Erythroplasia of Queyrat- It is a premalignant condition that can progress to squamous cell carcinoma. Occlusion with topical 5-fluorouracil cream applied once daily with the foreskin or a condom can be effective. It will induce a brisk reaction and superficial erosion, which can be uncomfortable.[13]
10. Basal cell carcinoma (BCC)- Topical therapy is most effective in treating superficial BCC. Topical imiquimod applied thrice weekly with occlusion is the favoured treatment.[14] Also, some studies have found occlusion therapy has no added effect on superficial BCC.
11. Keratoacanthoma- Commonly seen over lower legs, treated with 5-FU cream, and Unna boot occlusion therapy are useful approaches.[6]
12. Onychomycosis- A randomised control trial was conducted regarding the efficacy and safety of 1% clotrimazole cream occlusion and mechanical reduction for treating onychomycosis. At the end of the 16-month follow-up study, 88% (22 out of 25 nails) achieved complete cure.[15]

Occlusion alone may damage skin barrier function. Applying chemicals/drugs under occlusion can increase the penetration of chemicals and antigens into the skin, increasing dermatitis. Thus, it remains a double-edged sword.[8]

Common medications used for occlusion therapy, along with their side effects are tabulated in Table 4.

Common contraindication of occlusive therapy include maceration, infected lesions, allergy to occlusive material, and non-compliant patients.

Advancements in the design and construction of protective garments and wound dressings may reduce skin hydration and dermatitis. Applying optimal hydrocolloid patches that absorb water in both liquid and vapour form can also decrease irritation. A natural, pure, non-woven dressing made from calcium alginate fibers. It can rapidly absorb and retain wound fluid to form an integral jellified structure, maintaining an ideal moist wound healing environment. It can also trap and immobilise pathogenic bacteria in the jellified fibers network, stimulate macrophage activity, and activate platelets, resulting in hemostasis and accelerated wound healing.

Today, with the rapid development of new technologies in bioscience, we expect greater efficacy and development of dressings materials that can absorb excess water and reduce the unfavourable effects of occlusion.

Occlusion therapy, which finds an insignificant mention in most dermatology textbooks and guidelines for dermatological management, needs proper utilisation in clinical practice. Properly designed, controlled, randomised clinical studies are needed to confirm the exact role of occlusion therapy and its significance.

Table 4: Drugs used in occlusive therapy and their side effects

Drugs	Chronic side effects
Topical steroids	Thinning of skin, altered adrenal gland function, hypertension, hypokalemia, striae
Silica gel	Redness, contact irritant dermatitis
5-fluorouracil cream	Brisk reaction, superficial erosion
Imiquimod	Burning sensation, flaking of skin
Antibiotic solution	Hydration dermatitis
Urea	Burning, irritation

Declaration of patient consent: Patient's consent not required as there are no patients in this study.
Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.
Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirms that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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