COMPOUNDING FOR SCALP DISORDERS AND CONDITIONS

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Goals: The goals of this article are to provide information on the physiology and disorders of the scalp, and typical drug therapy used to treat these disorders.

Objectives Pharmacists & Technicians: At the conclusion of this lesson, the reader should be able to:
1. Discuss the physiology of the scalp and the function of the sebum, sweat glands and pores.
2. List at least five disorders/conditions of the scalp.
3. Describe different treatment approaches used in scalp disorders.
4. Recognize various formulations used in the treatment of seborrheic dermatitis, dandruff, psoriasis, hair loss, lice and ringworm.

Introduction
Scalp disorders may be painful, annoying, unsightly and embarrassing. Scalp problems may require short-term treatment, but many of them need long-term therapy over months, and sometimes years. Compounding pharmacists have a significant role in achieving successful therapeutic outcomes in this emerging field.

Anatomy and Physiology
The scalp consists primarily of the skin, sweat glands, sebaceous glands, hair shafts, and hair. When these appendages are not functioning properly in harmony with one another, various scalp disorders can occur.

Scalp: The scalp is the portion of the body consisting of skin and subcutaneous tissue normally containing hair that covers the neuro-cranium. It is especially rich in blood vessels; therefore, profuse bleeding may occur with scalp injuries. The functions of the scalp (skin) include protection and excretion. It secretes metabolic waste materials and toxins in order to rid the body of them. It also secretes sweat to cool the body, and sebum to protect the skin.

Skin: Each layer of the skin (epidermis, dermis, subcutaneous) has a specific function. Included in the skin are the sebaceous glands that produce sebum and secrete it through the sebaceous ducts into hair follicles, where it migrates to the surface of the skin. This flow of sebum removes dead skin cells that flake off from inside the hair follicle. Sebum consists of fatty acids and other substances and protects the skin by reducing the evaporation of water from the skin and blocks the penetration of excess water into the skin. This sebum is one of two constituents making up the lipid film present on the skin surface, the other being the lipids of the epidermal cells.

Pores: The pores in the skin are where the hair follicles reside. The pore size is related to sebaceous gland size. Pores enlarge to accommodate a greater oil flow. Acne caused by blocked pores often clears up when the pores enlarge allowing unimpeded movement of sebum through the pore.

Sweat Glands: Sweat glands consist of a single tube, the lower portion of which is coiled into a ball and the upper part (the duct) opens onto the surface of the skin. There are two types of sweat glands, the eccrine and the apocrine. The eccrine sweat glands, distributed all over the body, primarily regulate body temperature and eliminate toxic substances and waste products; the perspiration is clear and consists of traces of salt, carbohydrates, protein and oil. The sweat they produce is primarily odorless. The apocrine sweat glands are primarily in the underarm area, around the nipples and in the genital area. They are stimulated by the same hormones that stimulate hair growth in the underarms and genital area. The fluid they secrete is milky and rich in organic material that is subject to bacterial decay,
causing body odor. The hair entraps both sweat and bacteria.

Sebum: When the sebum gets stuck in the pores, whiteheads, blackheads, papules, pimples and cysts can ultimately occur. It is a result of the sebum getting blocked during its transport and clumping with dead skin cells, being acted upon by bacteria and ultimately blocking the opening to the skin surface. If pressure builds up, pustules and cysts result.

Hair: Hair grows on the scalp and each hair filament originates in a deep hair follicle which penetrates into the dermis. At the base of the follicle is the papilla which is the center of hair growth containing the capillaries and nerves that supply the hair. As new cells are formed and older cells are pushed upward, they gradually die and harden into a hair shaft, consisting of two layers, the cuticle and cortex. The outer layer, the cuticle, consists of flat, colorless, overlapping cells. The cortex contains pigment and a tough protein called keratin, forming the bulk of the hair shaft. Coarse hair, as on the scalp, contains an additional inner core called the medulla. The hair is lubricated by sebaceous glands that are located in the hair follicle. In general, human scalp hair is shed every two to four years; body hairs are shed more frequently.

Hair growth: Hair growth is cyclical, consisting of three phases. The growing phase is the “Anagen” phase; about 90% of scalp hairs are in the anagen phase at any point in time. On a daily basis, about 50 to 100 scalp follicles go into the resting phase, or the “Catagen” phase, which involves 1% of the hairs daily. The shedding phase is the “Telogen” phase and approximately 10-20% of scalp hairs may be in the telogen phase at any point in time.

CPE Quiz Question #1. Components of the scalp include:

- a. Skin
d. Sweat glands
c. Sebaceous glands
e. All of the above
b. Hair shafts

SCALP DISORDERS AND THEIR TREATMENT

Seborrheic Dermatitis and Dandruff
Description: Seborrheic dermatitis is an acute or chronic papulosquamous dermatitis presenting with dry scales and underlying erythema. In some cases pruritus is present. Dandruff occurs when there is a mild scaling without any erythema, and can occur if the scalp is dry or oily. It may be the result of several factors, including hormonal imbalance, impaired metabolic nutrition, diet, tension, increased bacterial and fungal activity, biochemical changes in the scalp, the use of topical medications and cosmetics. Seborrheic dermatitis occurs when there is general erythema without tight, thick, silvery scales. Psoriasis is evidenced by the presence of well-demarcated red plaques.

Treatment: Routine treatment for seborrhea of the scalp involves a shampoo that may contain tar, zinc pyrithione or selenium, used daily if necessary. A ketoconazole 1% or 2% shampoo can be used twice weekly. If needed, solutions or lotions of topical corticosteroids can be used twice daily.

Psoriasis
Description: Psoriasis is an inflammatory skin disease that may be based upon a genetic predisposition. When the skin is injured or irritated, it tends to induce lesions of psoriasis at the site. There are several variants of psoriasis, with the most common being the plaque type. Psoriasis presents as silvery scales on bright red, well-demarcated plaques that may be accompanied by itching.

Treatment: The treatment selected for psoriasis of the scalp is based on its extent and severity. Therapy can be initiated using a corticosteroid preparation. Other measures include tar preparations, such as coal tar solution (LCD, Liquor Carbonis Detergens), anthralin, calcipotriene and tazarotene. Treatment can be initiated with a tar shampoo used daily. For thick scales on the scalp, a 6% salicylic acid gel, or a phenol : mineral oil : glycerin mixture can be used. Alternatively, fluocinolone acetonide 0.01% in oil can be applied under a shower cap at night followed by tar shampoo in the morning. Corticosteroids such as triamcinolone, fluocinolone, betamethasone dipropionate, fluocinonide, amcinonide, or clobetasol in solution form can be used twice daily.

Hair Loss
I. Description: Pattern, or androgenetic baldness, is the most common form of alopecia. It is of genetic predetermination with the earliest changes occurring on the front sides of the scalp and at the crown of the skull. The extent of hair loss is variable and unpredictable, but may be experienced by approximately 80% of all men.

Treatment: A 5% solution of minoxidil alone or in combination with other active ingredients can be used in both male and female patients, generally twice daily. Those that respond are usually less than five years into their hair loss.

II. Description: Alopecia areata is believed to be the result of an immunologic process. Typically, there are patches that are smooth, without scarring. Tiny hairs, generally 2-3 mm in length, may be seen. In some cases, all the scalp hair may eventually be involved. Alopecia areata is a self-limiting disease where there may be
complete re-growth of hair in about 80% of cases. In some cases, mild alopecia areata is resistant to therapy.

**Treatment:** Severe forms may be treated by systemic corticosteroids; however, recurrences generally occur when therapy is discontinued. Corticosteroids can also be administered intraleesionally; for example triamcinolone acetonide 2.5 to 10 mg/mL can be injected in aliquots of 0.1 mL every 1 to 2 cm in the involved areas. The total dose should not exceed 30 mg per month for adults. Another treatment includes daily use of anthralin 0.5% ointment.

Other therapeutic approaches involve the use of topical diphenylcyclopropene and squaric acid dibutyl ester. These agents serve to sensitize the skin; this is followed by application of progressively weaker concentrations designed to produce a slight dermatitis. This results in hair re-growth in 3 to 6 months in some patients.

**III. Description:** Drug-induced alopecia may result from thallium, excessive vitamin A, retinoids, antimitotic agents, anticoagulants, antithyroid drugs, oral contraceptives, trimethadione, propranolol, indomethacin, amphetamines, salicylates, gentamicin and levodopa. Drug-induced alopecia is very disconcerting to the patient, but it is reversible when the causative agent is discontinued.

**Treatment:** No real treatment is indicated in such cases, other than discontinuation of the causative agent.

**Lice**

**Description:** *Pediculus humanus var capitis* (the head louse, approximately 3-4 mm long) is the causative agent for pediculosis of the skin of the scalp. It is presented as pruritis with excoriation and the presence of nits on hair shafts; they are easiest to see above the ears and at the nape of the neck. Head lice can be spread by individuals sharing hats or combs and it is epidemic among children of all socioeconomic classes, especially in elementary schools. Adults in close contact with children may also get the infestation.

**Treatment:** Options for treating head lice include ivermectin 0.8% lotion, malathion 0.5% or 1% lotion, permethrin 1% cream rinse and pyrethrins 0/17% to 0.33%. The ivermectin lotion is left on for 8 to 12 hours prior to rinsing off. The malathion is applied to the scalp and left on for about 12 hours. The permethrin cream rinse is left on from 30 minutes to 8 hours prior to rinsing off and treatment is repeated in one week. Following application of these preparations, it is important to meticulously remove the nits with a fine-tooth comb.

**Ringworm**

**Description:** Ringworm presents as a ring-shaped lesion with an advancing scaly border and central cleared area, or as scaly patches with a distinct border on the skin or scalp. The affected areas may also itch. *Trichophyton rubrum* is the most common causative agent.

**Treatment:** Many of the topical antifungal agents can be used, including miconazole, clotrimazole, ketoconazole, econazole, sulconazole, oxiconazole, ciclopirox, butenafine and terbinafine. Topical dosage forms commonly used include creams, solutions and gels. If the product is expected to be exposed to a wet environment, an ointment would be more appropriate. Treatment should be continued up to two weeks after symptoms have resolved.

**CPE Quiz Question #2. Common disorders of the scalp include all of the following, EXCEPT:**

- a. Hyperhidrosis
- b. Dandruff
- c. Seborrheic dermatitis
- d. Lice infestation
- e. Ringworm

**CPE Quiz Question #3. Individuals may have a genetic predisposition to:**

- a. Ringworm
- b. Lice
- c. Seborrheic dermatitis
- d. Psoriasis
- e. Dandruff

**CPE Quiz Question #4. Select the FALSE statement about lice infestations from the following:**

- a. It is epidemic among children of all socioeconomic classes.
- b. It presents with dry scale and underlying erythema.
- c. It is spread by sharing hats or combs.
- d. The nits on hair shafts are easiest to see above the ears and at the nape of the neck.
- e. Adults in close contact with children may also get the infestation.

**FORMULATIONS FOR TREATING SCALP DISORDERS AND CONDITIONS**

**General Applications for Pruritus of the Scalp**

**Rx Hydrocortisone 1% Antipruritic Scalp Lotion**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocortisone</td>
<td>1 g</td>
</tr>
<tr>
<td>Menthol</td>
<td>250 mg</td>
</tr>
<tr>
<td>Polysorbate 80</td>
<td>0.25 mL</td>
</tr>
<tr>
<td>Ethanol 95%</td>
<td>25 mL</td>
</tr>
<tr>
<td>Propylene glycol</td>
<td>25 mL</td>
</tr>
<tr>
<td>Purified water</td>
<td>100 mL</td>
</tr>
</tbody>
</table>

Mix the hydrocortisone and menthol with the Polysorbate 80. Add the propylene glycol and ethanol and mix well. Add sufficient purified water to volume and mix well. Package and label.
**Formulations for Seborrheic Dermatitis and Dandruff**

**Rx Selenium Sulfide 1% Shampoo**

- Selenium Sulfide 1 g
- Propylene glycol 5 mL
- Shampoo vehicle (commercial), qs 100 mL

Levigate the selenium sulfide with the propylene glycol. Add the shampoo vehicle to volume and mix well. Package and label.

**Rx Zinc Pyrithione 1% Shampoo**

- Zinc pyrithione 1 g (equivalent)
- Propylene glycol 10 mL
- Shampoo vehicle (commercial), qs 100 mL

Levigate the zinc pyrithione with the propylene glycol. Add the shampoo vehicle to volume and mix well. Package and label.

**Rx Triamcinolone 0.1% Scalp Lotion**

- Triamcinolone 100 mg
- Propylene glycol 25 mL
- Ethanol 95% 25 mL
- Purified Water, qs 100 mL

Mix the triamcinolone with the propylene glycol and ethanol. Add sufficient purified water to volume and mix well. Package and label.

**Rx Anti-Seborrhea Clear Lotion**

- Progesterone 500 mg
- Ethanol 95% 10 mL
- Ethoxy diglycol 50 mL
- Methylparaben 50 mg
- Propylparaben 20 mg
- Propylene glycol 1 mL
- Purified water, qs 100 mL

Dissolve the progesterone in the ethanol. Add the ethoxy diglycol. Dissolve the methylparaben and propylparaben in the propylene glycol and add to the progesterone solution. Add sufficient purified water to volume and mix well. Package and label.

**Rx Sulfur Shampoo**

- Sulfur (colloidal) 1 g
- Magnesium aluminum silicate 1 g
- Ammonium lauryl sulfate 40 g
- Lauramide DEA 4.5 g
- Sodium chloride 200 mg
- Methylparaben 50 mg
- Propylparaben 20 mg
- Purified water, qs 100 mL

Slowly add the magnesium aluminum silicate to about 50 mL of purified water while agitating and mix until smooth and uniform. Add the colloidal sulfur, ammonium lauryl sulfate, lauramide DEA, sodium chloride, methylparaben and propylparaben and mix well. Add sufficient purified water to volume and mix well. Package and label.

**Rx Phenol, Glycerin and Mineral Oil Shake Lotion**

- Phenol 1 g
- Glycerin 10 mL
- Purified water 20 mL
- Methylparaben 50 mg
- Propylparaben 20 mg
- Mineral Oil, Light, qs 100 mL

Dissolve the phenol, methylparaben and propylparaben in the glycerin. Add the purified water and mix well. Add the mineral oil and agitate. This is not an emulsion, but is an immiscible shake-type lotion.

**Formulations for Psoriasis**

**Rx Coal Tar Shampoo**

- Coal tar solution 2.8 g
- Polysorbate 80 5 mL
- Shampoo vehicle (commercial), qs 100 mL

Mix the coal tar solution with the polysorbate 80. Incorporate the shampoo vehicle and mix well. Package and label.

**Rx Coal Tar and Salicylic Acid Scalp Lotion**

- Coal tar solution 10 mL
- Salicylic acid 6 g
- Polysorbate 80 1 mL
- Ethanol 95% 20 mL
- Propylene glycol, qs 100 mL

Mix the polysorbate 80 with the coal tar solution. Mix the salicylic acid with the alcohol and about 60 mL of the propylene glycol. Add the coal tar solution mixture slowly with mixing to the propylene glycol mixture. Add sufficient propylene glycol to volume and mix well. Package and label.

**Rx Anthralin 1% and Coal Tar 1% Ointment**

- Anthralin 1 g
- Coal tar 1 g
- Polysorbate 80 2 g
- Aquaphor, qs 100 g

Mix the coal tar with the polysorbate 80 and incorporate the anthralin. Incorporate into the Aquaphor and mix until uniform. Package and label.

**Rx Anthralin 1% Medication Stick**

- Anthralin 200 mg
- Polyethylene glycol 3350 6.5 g
- Polyethylene glycol 300 15 mL
Mix the polyethylene glycols together by heating to a temperature of about 55°C. Incorporate the anthralin and mix well. Pour into medication stick molds and allow to cool. Package and label.

**Rx  Calcipotriene 0.003% Lotion**

- Calcipotriene 0.005% Cream 60 g
- Propylene glycol, qs 100 mL

Mix the commercial calcipotriene 0.005% cream with sufficient propylene glycol to make 100 mL. Package and label.

**Rx  Fluocinolone Acetonide 0.01% in Oil**

- Fluocinolone acetonide 10 mg
- Vegetable oil, qs 100 mL

Incorporate the fluocinolone acetonide into a vegetable oil, such as sesame oil, or almond oil, and mix well. Package and label.

### Formulations for Hair Loss

**Rx  Minoxidil 5% and Retinoic Acid 0.01% Scalp Lotion**

- Minoxidil 5 g
- Retinoic acid 10 mg
- Propylene glycol 20 mL
- Ethanol 95%, qs 100 mL

Mix the minoxidil and retinoic acid with the propylene glycol. Add sufficient ethanol to volume and mix well. Package and label.

**Rx  Minoxidil 2% and Finasteride 0.1% Scalp Lotion**

- Minoxidil 2 g
- Finasteride 100 mg
- Propylene glycol 20 mL
- Ethanol 95%, qs 100 mL

Pulverize the required number of finasteride tablets and mix with about 75 mL of ethanol in a covered container and let sit for a couple of hours. Filter through a paper filter to remove the excipients. Add the minoxidil and propylene glycol to the filtrate and mix well. Add additional ethanol to volume and mix well. Package and label.

**Rx  Spironolactone Scalp Lotion**

- Spironolactone 1 g
- Methylcellulose 0.25 g
- Ethanol 95% 40 mL
- Propylene glycol 20 mL
- Purified water, qs 100 mL

Mix the spironolactone and methylcellulose with the propylene glycol. Add the ethanol and mix well. Add sufficient purified water to volume and mix well. Package and label.

**Rx  Diphenylcyclopropenone 0.1% to 2% Solutions**

- Diphenylcyclopropenone 100 mg to 2 g
- Acetone, qs 100 mL

Dissolve the diphenylcyclopropenone in sufficient acetone to volume. Package and label. Caution: Diphenylcyclopropenone is a strong sensitizing agent. Exercise care when preparing these solutions; wear appropriate masks, garb and gloves.

**Rx  Squaric Acid Dibutyl Ester 0.1% to 1% Solutions**

- Squaric acid dibutyl ester 100 mg to 1 g
- Acetone or Ethanol 95%, qs 100 mL

Dissolve the squaric acid dibutyl ester in sufficient acetone or ethanol to volume. Package and label.

### Formulations for Lice Infestation

**Rx  Malathion 0.5% Topical Lotion**

- Malathion 500 mg
- Isopropyl alcohol 70% 70 mL
- Lavender oil 30 drops
- Bay oil 3 drops
- Ethanol 95%, qs 100 mL

Note: Compound this preparation in a well-ventilated area or use an exhaust hood, since malathion fumes can be irritating to the mucous membranes of the nasal passages. Wear disposable gloves to prevent retention of odor on the hands.

Disperse the malathion in the isopropyl alcohol. Add the fragrances and mix well. Add sufficient ethanol to volume and mix well. Package and label.

**Rx  Ivermectin 1% Creme Rinse**

- Ivermectin 1 g
- Polyethylene glycol 300 17 mL
- Creme Rinse (Commercial), qs 100 mL

Mix the ivermectin with the polyethylene glycol 300 to form a smooth paste. Incorporate the creme rinse and mix well. It may be necessary to work the product in a mortar with a pestle to ensure uniform and small particle size of the ivermectin. Package and label.

**Rx  Ivermectin 1% Lotion**

- Ivermectin 1 g
- Propylene glycol 15 mL
- Dermabase 30 g
- Purified water, qs 100 mL

Mix the ivermectin with the propylene glycol to form a smooth paste using a mortar and pestle. Incorporate the Dermabase and mix well. Slowly add sufficient purified water to volume and mix well. Package and label.

### Formulations for Ringworm
Rx  Clotrimazole 1% Scalp Lotion

Clotrimazole 1 g
Propylene glycol 50 mL
Polyethylene glycol 300, qs 100 mL

Dissolve the clotrimazole in the propylene glycol and add sufficient polyethylene glycol 300 to volume and mix well. Package and label.

Rx  Miconazole 1% and Tolnaftate 1% Scalp Lotion

Miconazole 1 g
Tolnaftate 1 g
Propylene glycol 50 mL
Polyethylene glycol 300, qs 100 mL

Dissolve the miconazole and tolnaftate in the propylene glycol and add sufficient polyethylene glycol 300 to volume and mix well. Package and label.

Rx  Ketoconazole 2% Solution

Ketoconazole 2 g
Polyethylene glycol 300 80 mL
Propylene glycol 20 mL

Dissolve the ketoconazole in the polyethylene glycol 300 and propylene glycol and mix well. Package and label.

Note: With the exception of a few formulations containing drugs such as triamcinolone, fluocinolone acetonide, spironolactone, finasteride, and squaric acid dibutyl ester, the remaining preparations can be dispensed over-the-counter.

CPE Quiz Question #5. All of the following may be used to treat psoriasis, EXCEPT:

a. Coal tar solution  d. Anthralin
b. Minoxidil  e. Clobetasol
c. Fluocinolone acetonide

c. Hydrocortisone

CPE Quiz Question #7. All of the following may be used to treat a lice infestation, EXCEPT:

a. Terbinafine  d. Permethrin
b. Malathion  e. Pyrethrins
c. Ivermectin

CPE Quiz Question #8. Squaric acid dibutyl ester can be used in the treatment of:

a. Seborrheic dermatitis  d. Alopecia
b. Dandruff  e. Lice
c. Psoriasis

CPE Quiz Question #9. Seborrhea of the scalp may be treated with:

a. Zinc pyrithione  b. Selenium
c. Ketoconazole shampoo  d. Topical corticosteroids
e. All of the above

CPE Quiz Question #10. Special precautions are required when dealing with the following drugs:

I. Malathion
II. Diphenylcyclopropenone
III. Coal tar

a. I only  d. II and III only
b. III only  e. I, II and III
c. I and II only

References