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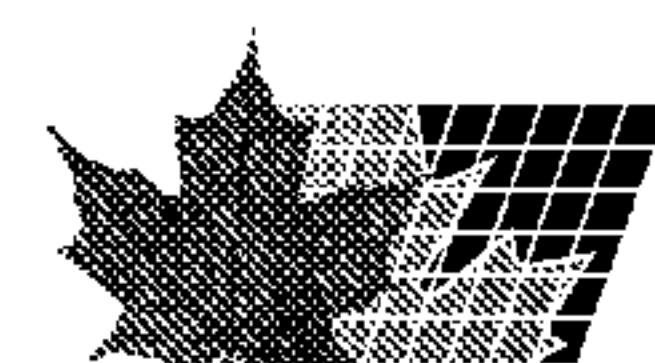
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(54) Titre : TIMBRES TRANSDERMIQUES ET METHODES POUR ADMINISTRER LA TESTOSTERONE
(54) Title: SKIN PATCHES AND METHODS FOR PROVIDING TESTOSTERONE

(57) **Abrégé/Abstract:**

A method of providing testosterone replacement therapy to a woman in need of such therapy comprising applying a testosterone-delivering patch to the skin of said woman which patch transdermally delivers 50 to 500 µg/day of testosterone to the woman.

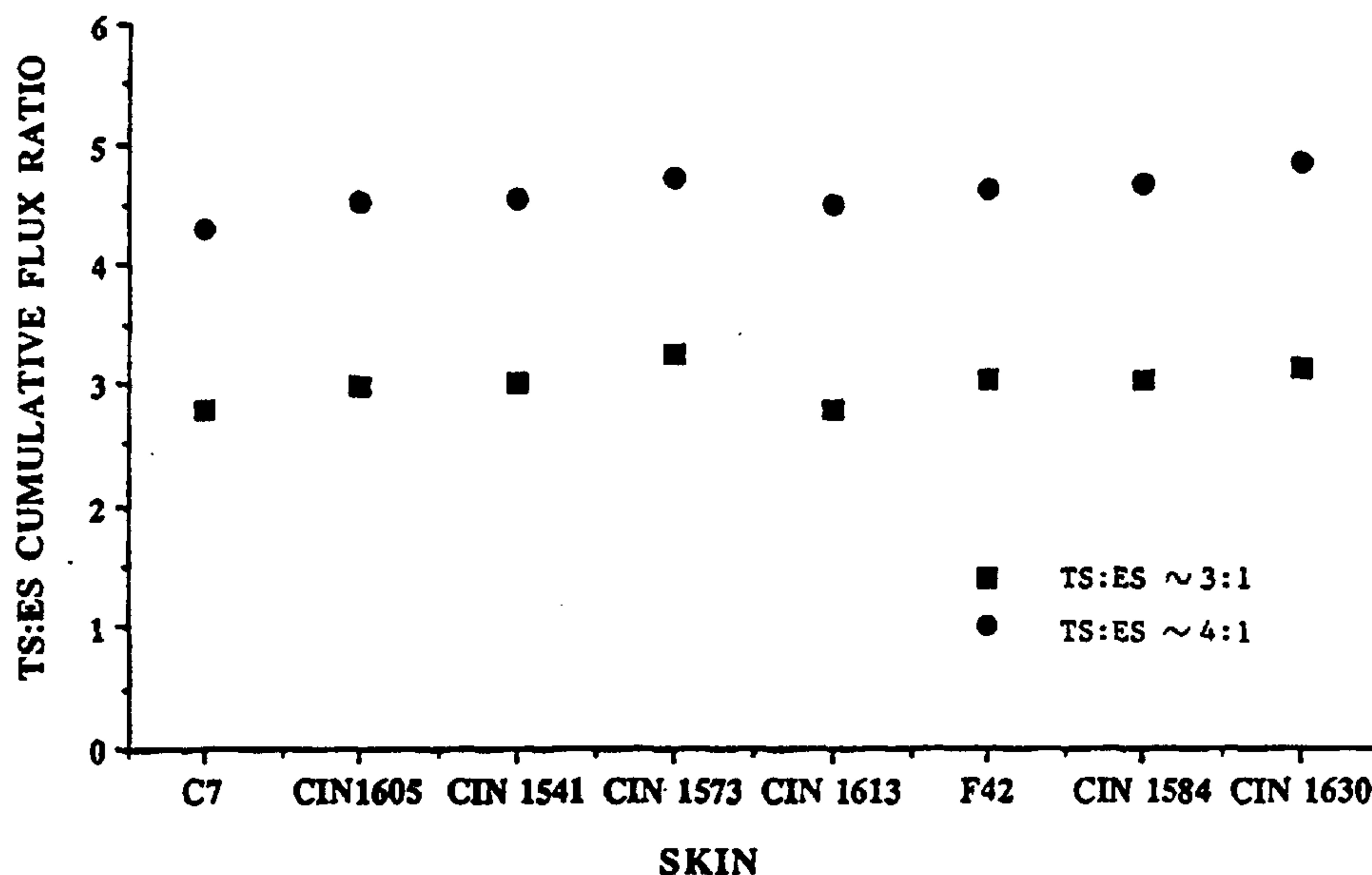




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(54) Title: SKIN PATCHES AND METHODS FOR PROVIDING TESTOSTERONE



(57) Abstract

A method of providing testosterone replacement therapy to a woman in need of such therapy comprising applying a testosterone-delivering patch to the skin of said woman which patch transdermally delivers 50 to 500 $\mu\text{g/day}$ of testosterone to the woman.

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SKIN PATCHES AND METHODS FOR PROVIDING TESTOSTERONE

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DescriptionTechnical Field

15 This invention is in the field of transdermal drug delivery. More particularly, it is directed to skin patches and methods for providing transdermal delivery of testosterone and optionally estrogens to women.

Background

20 Estrogens are commonly used in hormone replacement therapy for the treatment of post-menopausal symptoms and osteoporosis. Many women, however, continue to experience symptoms after estrogen monotherapy. The beneficial effects of androgens on the post-menopausal woman's physical and emotional well-being are only
25 recently being recognized. Several clinical studies have established the basis of combined estrogen-androgen therapy. In a series of double-blind, controlled studies at McGill University, it was noted that patients on estrogen-androgen combination therapy had higher daily
30 scores of well-being, energy level, and quality of sleep than patients on estrogen replacement therapy (ERT) alone. The authors also reported a beneficial effect of estrogen-androgen therapy on sexual function, and no adverse effects on lipids.

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Androgens are the hormones of choice in helping restore lost sex drive, although estrogens alone may help some women. Several reports in the literature establish the beneficial effects of androgen therapy on sexual function. This is particularly important in younger, surgically post-menopausal women, who have increased motivational aspect of sexual behavior (such as desire and arousal) when treated with parenteral androgen, either alone or in combination with an estrogen, compared to estrogen alone or placebo. Justification for the addition of androgens to ERT for the prevention of osteoporosis is also found in the literature.

While the benefits of adding an androgen to an ERT regimen are well established, the dosage forms available for androgen therapy or estrogen-androgen combination therapy leave much to be desired. In particular, none of these modalities can produce serum testosterone levels that remain within normal physiological range on a daily basis. The androgens most available for clinical use are not typically the native testosterone; synthetic androgens are commonly used (methyl testosterone, for example which is known to be hepatotoxic). Native testosterone is available as implantable pellets; however this system requires an invasive administration and does not produce a stable physiological hormonal state. Injectable testosterone esters such as testosterone propionate and the long-acting testosterone enanthate produce marked supraphysiological fluctuations in hormone levels. The non- and supraphysiological nature of the current androgen replacement products are responsible for the signs and symptoms of excess androgen effect frequently seen with their use. These include virilizing symptoms such as hirsutism, male pattern baldness, voice lowering and clitoromegaly; disturbances in ovulation and

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menstrual function; acne and oily skin; and breast
tenderness, fluid retention, irritability and depression.
These problems are also present with estrogen-androgen
products currently on the market. A modality producing
5 physiological levels of testosterone and its metabolites,
with or without estrogen, would have significant
therapeutic benefits over existing androgen replacement
products.

Many articles and patents have suggested or
10 reported transdermal administration of testosterone. In
general, these publications have focused on providing
testosterone therapy to men to treat conditions such as
male hypogonadism, anemia, and male osteoporosis. Much
of this literature concludes that testosterone, without
15 some form of permeation enhancement, does not pass
through non-scrotal skin at practical fluxes. Most
recently, U.S. 5,152,997 describes the transdermal
administration of testosterone to males through non-
scrotal skin under conditions (subsaturation
20 concentrations of testosterone in the skin patch;
coadministration of skin permeation enhancers) that
provide practical flux levels. This literature is
virtually silent on the subject of providing testosterone
or combined testosterone/estrogen replacement therapy to
25 women transdermally.

Disclosure of the Invention

One aspect of this invention is a method of
providing testosterone replacement therapy to a woman in
30 need of such therapy comprising administering
testosterone transdermally to the woman in an amount that
provides blood levels of testosterone in the woman that
correspond substantially to endogenous blood levels of
testosterone in healthy young adult women.

Another aspect of the invention is a skin patch for providing testosterone replacement therapy transdermally to a woman in need of such therapy comprising a laminated composite of:

- (a) a backing layer; and
- (b) a matrix layer comprising a solution of testosterone in a polymeric carrier, said matrix layer providing a sufficient daily dose of testosterone to provide said therapy.

Still another aspect of the invention is a method of providing combined testosterone and estrogen replacement therapy to a woman in need of such therapy comprising coadministering testosterone and estrogen transdermally to the woman in respective amounts that provide blood levels of testosterone and estrogen in the woman that correspond substantially to endogenous blood levels of testosterone and estrogen in healthy young adult women.

Yet another aspect of the invention is a skin patch for providing testosterone and estrogen replacement therapy transdermally to a woman in need of such therapy comprising:

- (a) a backing layer;
- (b) a testosterone-and-estrogen-containing reservoir layer that is adapted to be in diffusional communication with the skin of the woman and to transmit therapeutically effective amounts of testosterone and estrogen through the skin of the woman.

Finals aspects include the use of a transdermal form of testosterone for providing testosterone replacement therapy to a woman in need of such therapy wherein the transdermal form delivers to the woman an amount that provides blood levels of testosterone in the woman that correspond substantially to endogenous blood levels of testosterone in healthy young adult women; and the use

of a coadministerable transdermal form of testosterone and estrogen for providing combined testosterone and estrogen replacement therapy to a woman in need of such therapy wherein the transdermal form delivers to the woman in respective amounts that provide blood levels of testosterone and estrogen in the woman that correspond substantially to endogenous blood levels of testosterone and estrogen in a healthy young woman.

Brief Description of the Drawing

The drawing is a graph of data described in Example 2, *infra*.

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Modes for Carrying Out the Invention

As used herein, the word "estrogen" intends 17 β -estradiol; esters thereof such as estradiol-3,17-diacetate, estradiol-3-acetate, estradiol-17-acetate, 5 estradiol-3,17-divalerate, estradiol-3-valerate, estradiol-17-valerate, and the corresponding pivalate, propionate, cypionate, benzoate, and like esters; ethinyl estradiol, estrone, and other estrogenic steroids and derivatives thereof that are suitable for transdermal 10 administration. Correspondingly, the term "testosterone" intends testosterone and pharmaceutically acceptable derivatives thereof such as the enanthate, propionate and cypionate esters of testosterone.

As used herein, the term "testosterone 15 replacement therapy" intends the transdermal administration to a woman of all or a portion of the testosterone that is normally produced by a healthy young adult woman. In this regard, in healthy adult women approximately 50% of the testosterone is produced by each 20 of the ovaries and the adrenal glands. Thus, in most instances this therapy will be provided to women who have undergone bilateral oophorectomy, post-menopausal with diminished androgen production, and women with diminished adrenal androgen production (e.g., Addison's disease). 25 This latter group also includes women who receive high dose corticosteroid therapy that can secondarily suppress adrenal androgen production.

As used herein the term "flux" intends the rate of transfer of hormone across skin as measured by the 30 method of Merritt and Cooper (J Controlled Release (1984) 1:161).

The term "endogenous serum levels" as used herein intends the serum levels of testosterone or estradiol, as the case may be, that are normally found in 35 healthy young adult women. In the case of testosterone

this value is about 15 to 80 ng/dL; whereas for estradiol it is about 25 to 200 pg/mL. In the case of derivatives of testosterone or estradiol, amounts that provide equivalent androgenic or estrogenic activity, as the case
5 may be, to the natural hormones are intended. The term "corresponds substantially" intends a permitted standard deviation of $\geq 100\%$ in the case of both testosterone and estradiol.

The term "diffusional communication" intends
10 that when the invention patch is placed on the skin/mucosa of a woman, there is a direct or indirect diffusional pathway by which the testosterone and optionally estrogen can migrate from the hormone-containing element(s) of the patch to the skin/mucosa of
15 the wearer.

The daily dose of testosterone that will normally be required to provide replacement therapy to females is in the range of 50 to 500 $\mu\text{g/day}$, more usually 100 to 300 $\mu\text{g/day}$. Correspondingly, the daily dose of
20 17β -estradiol will normally be in the range of 25 to 200 $\mu\text{g/day}$, more usually 50 to 100 $\mu\text{g/day}$. Thus, for patches in the 5 to 30 cm^2 diffusional area range, the flux of testosterone will be in the range of 1.7 to 100 $\mu\text{g/cm}^2/\text{day}$, more usually 3.3 to 60 $\mu\text{g/cm}^2/\text{day}$ whereas the
25 flux of estradiol will usually be in the range of 0.8 to 40 $\mu\text{g/cm}^2/\text{day}$, more usually 1.7 to 20 $\mu\text{g/cm}^2/\text{day}$.

The patches that are used to provide such daily doses of testosterone and optionally estradiol may be of the matrix or container type. In matrix-type patches,
30 the hormone(s) is/are homogeneously blended in a solid or semisolid polymer carrier together with other additives (e.g., permeation enhancers, plasticizers, viscosity reducing agent, and the like). In container-type devices, the hormones are typically dissolved or
35 suspended in liquid or semi-solid vehicles, and confined

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within a pouch or space between a backing and an underlying membrane which is permeable to the hormone(s). The general structure and fabrication of both matrix and container-type patches are well known in the art.

5 A preferred patch for administering testosterone or testosterone/estrogen in accordance with this invention is a matrix-type patch which comprises an occlusive backing that is impermeable to the testosterone/estrogen and defines the face or top surface
10 of the patch and a solid or semisolid matrix layer comprised of a homogeneous blend of the hormone(s), a polymeric carrier, and one or more skin permeation enhancers.

The particular chemistry of the polymeric
15 carrier is not critical. Rather, the diffusion coefficient of the hormone(s) in the carrier and the solubilities of the hormone(s) in the carrier are important. In this regard the diffusion coefficient of the hormone(s) in the carrier will usually be between
20 10^{-4} and 10^{-12} cm²/sec, more usually 10^{-5} and 10^{-8} cm²/sec. Correspondingly, the solubilities of the hormones in the carrier will usually be in the range of 1 to 200 mg/cm³, more usually 10 to 100 mg/cm³. The amount of testosterone and optionally estrogen in the carrier
25 will be sufficient to provide the required daily dose of hormone(s) over the intended wearing time. The hormone(s) are preferably present in the carrier below their saturation concentrations to avoid crystallization. The patches will be typically designed to be worn for 1
30 to 14 days, more usually 1 to 7 days. Accordingly, the amount of testosterone in the carrier will normally be between 0.1 to 30 mg, more usually 1 to 10 mg and the amount of estrogen, when present, will usually be between 0.1 and 10 mg, more usually 0.5 and 5 mg. The thickness
35 of the matrix layer will normally be 0.01 to 1 mm, more

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usually 0.025 to 0.25 mm. The area of the patch in diffusional contact with the skin will usually be between 1 and 150 cm², more usually 5 and 40 cm². The polymeric carrier may be adhesive or nonadhesive. When it is a pressure sensitive adhesive the basal surface of the matrix layer may be used to affix the patch to the skin. When it is not, other means such as an underlying adhesive layer, a peripheral adhesive layer, an adhesive overlay, or straps may be used to affix the patch to the skin.

Examples, without limitation, of specific polymers that may be used as the carrier are polyacrylates, polymethacrylates, natural and synthetic rubbers, silicone rubbers and elastomers, polyolefins, vinyl copolymers, urethanes, nylons, polyesters, polyethers, and the like.

The skin permeation enhancer(s) that are included in the matrix enhance the level of skin flux of the hormone(s). Examples, without limitation, of skin permeation enhancers that may be used are those described or referred to in U.S. Pats. Nos. 5,122,383 and 5,152,997. The enhancer will usually constitute 1 to 20 wt% of the matrix, more usually 5 to 15 wt% of the matrix.

The patches of the invention may be manufactured by conventional techniques used in transdermal drug delivery device art. For instance, the hormone(s), carrier, and enhancer(s) may be mixed in the desired proportions to form a homogeneous mixture and cast or otherwise applied to a backing layer, by lamination to a release liner layer.

The following examples further illustrate the invention. These examples are not intended to limit the

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invention in any manner. Unless indicated otherwise percentages and proportions are by weight.

Examples

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Example 1

Testosterone (TS) was obtained from the Upjohn Company. Sorbitan monooleate (ArlacelTM 80) was obtained from ICI Americas. Polyacrylate adhesive (DurotakTM 80-
10 1196) was obtained from National Starch and Chemical Company. Release liner (polyester, S242M) was obtained from Release Technologies, Inc. and polyethylene backing film (CotranTM 9720) from 3M Corporation.

The solid content of the adhesive was
15 determined by weighing a small amount of the adhesive solution in a pre-weighed aluminum dish. The solvent was evaporated by overnight drying in a convection oven maintained at 70°C and the % solid adhesive content determined based upon the weight of the dried adhesive.

20 Known amounts of the adhesive solution were weighed into glass bottles. From the weight of the adhesive solution and the percent solid adhesive content, the amount of adhesive in the solution was calculated. Appropriate quantities of testosterone and sorbitan
25 monooleate were added to the adhesive solution to yield a dried film composition in which the adhesive, testosterone, sorbitan monooleate were in a weight ratio of 83:2:15. The glass bottle was then tightly capped, sealed with parafilm, and rotated overnight until all
30 ingredients had completely dissolved and the solution was visually clear.

About 8 ml of the adhesive/testosterone/
sorbitan monooleate mixture was then dispensed on a release liner, and cast with a 250 micron gap casting
35 knife. This cast was dried in a convention oven at 70°C

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for 15 minutes to yield a dry film thickness of approximately 60 microns. The backing film was then laminated onto this adhesive film using a rubber roller. This matrix laminate was used to conduct *in vitro* skin flux studies.

Similar laminates were made using other enhancers (glyceryl monooleate, methyl laurate, ascorbyl stearate, and ascorbyl palmitate) and different amounts of enhancer (5%-15% by weight), and different TS loadings at 15% enhancer loading.

The *in vitro* skin flux studies were conducted by the general method of Merritt and Cooper, *supra*, using modified Franz diffusion cells. Heat separated human epidermal membrane was cut into rectangular strips. The matrix was also cut into corresponding rectangular strips. After the release liner was peeled and discarded, the matrix was laminated onto the stratum corneum surface of the epidermal membrane. The skin-matrix sandwich was then cut into smaller pieces for loading onto the diffusion cells. Each piece of the skin matrix sandwich was loaded between the donor and receiver compartments of a diffusion cell, with the epidermal side facing the receiver compartment, and clamped in place. The receiver compartment was then filled with 0.02% sodium azide solution. The solubility of the testosterone in this medium is adequate to ensure sink conditions throughout the experiment. The cell was then placed in a circulating water bath calibrated to maintain the skin surface temperature at $32 \pm 1^\circ\text{C}$.

At predetermined intervals, the entire contents of the receiver compartment was collected for TS quantitation, and the receiver compartment was refilled with fresh receptor medium, taking care to eliminate any air bubbles at the skin/solution interface. The

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cumulative amount of TS permeated per unit area at any time t (Q_t , $\mu\text{g}/\text{cm}^2$) was determined as follows:

$$Q_t = \sum_{n=0}^t (C_n * V) / A$$

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where C_n is the concentration ($\mu\text{g}/\text{ml}$) of drug in the receiver sample for the corresponding sample time, V is the volume of fluid in the receiver chamber ($\sim 6.3 \text{ cm}^3$), and A is the diffusional area of the cell (0.64 cm^2).

10 The slope of the best fit line to the Q_t vs. t plot gives the steady state flux (J_{ss} , $\mu\text{g}/\text{cm}^2/\text{h}$); the intercept of this line on the time axis gives the lag time (t_L , h).

Reverse-phase HPLC was used to determine the concentration of TS in samples from *in vitro*. The HPLC methodology is summarized below.

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Mobile Phase:	47/53 % (v/v) Acetonitrile/ H_2O
Flow Rate:	1.0 ml/min
Column:	Partisphere C18, 10 cm (Whatman)
Injection Volume:	50 μL
20 Wave Length:	245 nm
Retention Time:	4.5-4.8 min
Run Time:	6 min

25 From these studies a twice-a-week (i.e., to be worn ~3-4 days) prototype testosterone patch was designed. The matrix formulation of the prototype patch is Durotak 80-1196 (83%)/TS (2%)/Arlacel 80 (15%). The coating weight of the matrix is $91 \pm 9.1 \text{ mg}$; the size is 15 cm^2 , and the daily dose is approximately $150 \mu\text{g}/\text{day}$.

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Example 2

Estradiol (ES) was obtained from Diosynth, Inc. Other materials were obtained as described in Example 1.

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Based on the studies of Example 1 two patches which coadminister TS and ES were made. One was designed to have a TS:ES flux of 4:1; the other a 3:1 flux ratio. The matrix composition of the 4:1 patch was Durotak 80-1196 (80.5%)/Arlacel 80 (15%)/ES (1.5%)/TS (3%). The matrix composition of the 3:1 patch was Durotak 80-1196 (81.5%)/Arlacel 80 (15%)/ES (1.5%)/TS (2%). Other patch components were as in Example 1.

Flux studies were carried out on these patches as in Example 1. The drawing is a plot of the data from these studies. Specifically the drawing shows the TS:ES flux ratio for each of 8 skin samples. Based on these studies a 3:1 ratio 10-20 cm² patch targeted to deliver ~150 µg/day TS and 50 µg/day ES was developed.

Example 3

A clinical study of the patches described in Examples 1 (designated TMTDS) and 2 (designated ETMTDS) (both prototypes were 15cm² in surface area) was carried out. The study was designed to evaluate the serum concentrations of testosterone and estradiol in postmenopausal women obtained by wearing the patches for 96 hr. Details of the study follow:

a) Subject Population

Twelve healthy women ranging in age from 36 to 61 years participated. All had undergone bilateral oophorectomy and hysterectomy.

b) Treatment Schedule

Each subject received treatment in a balanced randomized crossover sequence involving two treatment periods. In each treatment period one patch was worn for 96 hours. A washout period of two weeks separated the start of each period. The patches were worn on alternate sides of the upper outer quadrant of the buttocks below the waistline.

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c) Blood Samples

Samples were obtained prior to, during, and following each patch application in each treatment period. Pre-application samples were used to determine the pattern of circadian variation on endogenous hormone production. They were obtained at -24, -22, -20, -18, -16, -12, and -1 hours. During patch wearing samples were obtained at 2, 4, 6, 8, 12, 24, 36, 48, 60, 72, 84, and 96 hours. Post-administration samples were obtained at 98, 100, 108 and 120 hours. Samples were analyzed for testosterone (T), estradiol (E2) dihydrotestosterone (DHT), dihydroepiandrosterone (DHEA), and estrone (E1) content.

d) Levels of Hormones in Serum

1. TMTDS

Serum concentrations of testosterone increased steadily after system application and reached a plateau within 8-12 hours. Even though mean (SD), uncorrected C_{max} for T was 35.5 ng/dl (Range: 16-53 ng/dl), serum concentrations did not significantly differ over the dosing interval between 24 and 96 hours. Mean (SD) C_{max} for estradiol and estrone were 7.5 and 27.0 pg/ml respectively. These values differ slightly from average baseline values, 3.0 for estradiol and 19.2 for estrone, and may reflect ultimate metabolic products of exogenous testosterone, but are probably not significant in quantity. DHT, the primary metabolite of testosterone, also slowly increased during the wearing period and achieved a mean (SD) C_{max} of 7.8 ng/dl (Range: 4-11 ng/dl). During the dosing interval DHT concentrations remained in a fairly narrow plateau similar to T concentrations. During the TMTDS wearing period, DHEA concentrations ranged from 134-1091 ng/dl. The circadian pattern associated with DHEA concentrations was not perturbed by the exogenous delivery of

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testosterone from the TMTDS. Mean (SD) concentrations of each of the hormones measured during the TMTDS wearing period are tabulated in Table 1 below.

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TABLE 1

TIME Hours	TESTOSTERONE (ng / dl)		ESTRONE (pg / ml)		ESTRADIOL (pg / ml)		DHT (ng / dl)		DHEA (ng / dl)	
	MEAN	St. Dev	MEAN	St. Dev	MEAN	St. Dev	MEAN	St. Dev	MEAN	St. Dev
.24	11.1	7.7	21.7	5.6	3.7	3.3	3.0	3.0	276.7	182.8
.22	9.3	7.9	19.0	5.9	2.8	3.0	2.1	2.3	214.0	88.9
.20	8.5	6.1	18.4	6.9	2.6	3.2	1.7	2.2	208.7	96.0
.18	7.6	5.7	20.0	7.2	2.9	3.1	1.7	2.1	193.3	104.4
.16	7.3	5.7	17.8	8.1	3.2	3.1	1.6	2.0	203.3	135.0
.12	7.7	6.9	17.9	8.6	2.9	3.1	1.4	2.1	193.8	129.6
.1	14.3	10.7	22.8	7.9	2.9	3.1	3.4	3.4	482.1	342.7
2	10.1	7.2	19.0	6.9	3.3	3.5	2.4	2.3	244.0	166.1
4	18.4	11.5	21.7	9.0	3.2	4.2	3.0	2.5	254.5	170.2
6	21.9	14.7	19.5	8.7	2.5	3.2	4.2	2.6	222.0	102.9
8	29.0	15.1	20.6	7.7	2.5	3.5	5.1	2.3	222.9	117.7
12	28.4	13.8	17.5	7.6	2.6	3.7	5.8	2.1	186.2	104.0
24	27.8	12.1	22.8	7.3	3.0	3.5	6.2	3.3	318.3	177.0
36	26.3	11.6	21.3	8.2	4.5	3.8	6.6	2.4	207.5	134.3
48	27.5	13.7	21.8	8.4	2.7	3.3	5.9	3.1	263.4	168.1
60	27.0	12.3	20.7	5.6	3.4	4.4	5.7	1.6	200.2	63.6
72	25.2	14.3	20.5	8.2	3.8	3.4	5.8	3.3	310.5	298.7
84	25.4	13.9	16.6	8.6	2.5	2.9	5.1	2.4	164.2	81.4
96	23.2	11.3	21.5	7.6	2.2	3.1	5.9	2.3	285.6	165.2
98	16.4	9.8	18.7	7.2	2.2	3.0	4.0	3.0	222.2	142.2
100	14.2	9.7	18.8	10.0	3.3	4.8	3.4	2.4	188.4	104.2
108	7.8	5.6	17.5	7.6	2.7	3.3	1.0	1.8	158.4	83.6
120	11.5	7.4	20.6	6.2	3.0	3.2	2.7	2.6	296.6	184.0

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2. ETMTDS

Serum concentrations of testosterone and estradiol increased soon after application and reached plateau levels within 12-24 hours. Mean (SD) peak uncorrected serum concentrations of T was 33.7 ng/dl (Range: 11-64 ng/dl) while C_{max} for estradiol was 42.9 pg/ml (Range: 21-70 pg/ml). The primary metabolites of T and E2, DHT and estrone, had mean C_{max} of 7.3 ng/dl and 36.8 pg/ml, respectively. The concentrations of T, E2, DHT, and E1 were all maintained in a narrow range over hours 24 - 96. As was the case for the TMTDS patch, DHEA serum concentrations maintained their characteristic circadian pattern (Range: 259 - 771) and appear to be unaffected by delivery of the exogenous sex hormones. Mean (SD) concentrations of each of the hormones measured during the ETMTDS wearing period are presented in Table 2 below.

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TABLE 2

TIME Hours	TESTOSTERONE (ng / dl)		ESTRONE (pg / ml)		ESTRADIOL (pg / ml)		DHT (ng / dl)		DHEA (ng / dl)	
	MEAN	St. Dev	MEAN	St. Dev	MEAN	St. Dev	MEAN	St. Dev	MEAN	St. Dev
-24	12.9	9.8	21.6	6.6	3.3	2.9	2.6	2.9	294.2	179.2
-22	9.5	6.3	16.1	6.8	4.9	3.4	2.0	2.3	242.1	139.5
-20	9.7	7.3	17.1	7.1	2.1	3.1	1.4	2.0	242.1	164.2
-18	7.8	5.4	16.8	6.2	2.0	3.0	1.8	2.0	199.8	83.2
-16	8.8	6.7	18.6	7.3	4.1	3.1	1.4	1.8	209.7	114.6
-12	9.1	5.7	18.0	7.1	2.5	3.3	0.7	1.7	199.7	71.2
-1	15.1	11.7	20.8	7.0	2.1	3.8	2.2	2.9	408.2	278.5
2	10.4	6.9	18.9	5.3	3.7	3.3	1.6	2.0	208.5	81.6
4	15.0	10.0	20.0	6.0	8.4	7.2	2.0	2.4	226.1	115.4
6	19.2	11.6	20.7	6.4	15.8	11.5	3.1	2.1	228.9	142.2
8	26.6	17.5	22.8	7.4	24.8	17.8	4.0	3.0	227.8	104.2
12	23.0	12.9	22.9	6.5	23.5	9.5	4.4	3.1	201.3	120.8
24	29.3	11.0	31.9	6.7	32.8	13.5	6.7	2.8	349.4	183.1
36	27.1	12.7	31.9	6.8	37.2	16.4	5.0	3.7	178.8	78.2
48	28.1	13.2	34.3	7.7	32.6	15.2	5.8	2.5	294.9	164.0
60	25.8	12.7	32.9	9.2	36.0	16.0	4.7	1.6	171.8	67.2
72	24.1	10.1	33.3	7.0	31.1	9.7	5.5	2.8	282.3	141.6
84	24.6	12.3	31.2	5.8	34.6	13.6	4.2	2.6	175.1	68.2
96	24.8	11.8	31.8	7.4	29.0	11.4	5.2	2.9	265.5	120.3
98	18.1	10.2	29.9	7.0	20.4	5.8	4.4	2.3	247.5	133.6
100	12.1	8.6	30.1	7.3	15.0	4.3	2.4	2.7	198.5	75.7
108	8.6	6.1	25.2	7.1	7.6	3.5	1.4	2.3	168.4	6505.0
120	10.7	7.5	26.6	6.3	4.5	3.8	2.6	2.6	284.3	189.6

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e. Conclusions

The TMTDS and ETMTDS were well tolerated by this population of postmenopausal, oophorectomized women. There were no significant skin or systemic adverse effects reported during the study. Both testosterone and estradiol were well absorbed from these formulations and resulting serum concentrations of both hormones approach the levels anticipated from in-vitro evaluation in a sustained manner over the proposed dosing interval.

The TMTDS raised circulating testosterone concentrations into the 25-30 ng/dl range, as did the ETMTDS, without excessive production of the major androgenic metabolite, DHT.

Delivery of estradiol from the ETMTDS provided mean incremental increases of circulating estradiol in the 25 to 30 pg/ml range.

Modifications of the above described modes for carrying out the invention that are obvious to those of skill in the fields of pharmaceuticals, hormone replacement therapy, transdermal drug delivery and related arts are intended to be within the scope of the following claims.

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CLAIMS:

1. A use of testosterone in the manufacture of a medicament for the transdermal administration to a woman of an amount of testosterone of from 50 to 500 $\mu\text{g/day}$, thereby causing blood levels of testosterone in the woman to be from about 15 to about 80 ng/dl.
2. A use of 50 to 500 $\mu\text{g/day}$ of transdermally-administrable testosterone for causing blood levels of testosterone in a woman to be from about 15 to about 80 ng/dl.
3. The use according to claim 1 or 2, wherein the amount of testosterone is from 100 to 300 $\mu\text{g/day}$.
4. The use according to claim 1, further comprising the use of estrogen in the manufacture of a medicament, further adapted for transdermal administration to a woman of an amount of estrogen equivalent to about 25 to about 200 $\mu\text{g/day}$ of 17β -estradiol, thereby resulting in an estrogenic activity level in the woman equivalent to a 17β -estradiol blood level of from about 25 to about 200 pg/ml.
5. The use according to claim 2, further comprising the use of estrogen, further adapted for transdermal administration to a woman of an amount of estrogen equivalent to about 25 to about 200 $\mu\text{g/day}$ of 17β -estradiol, thereby resulting in an estrogenic activity level in the woman equivalent to a 17β -estradiol blood level of from about 25 to about 200 pg/ml.

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6. The use according to claim 4 or 5, wherein the estrogen is 17β -estradiol.

7. A skin patch for providing testosterone replacement therapy transdermally to a woman in need of such therapy, the patch comprising a laminate of:

(a) a backing layer; and

(b) a matrix layer comprising a solution of testosterone in a polymeric carrier, the matrix layer containing a testosterone concentration sufficient for administering testosterone transdermally in an amount ranging from 50 to 500 $\mu\text{g}/\text{day}$, thereby causing blood levels of testosterone in the woman to be from about 15 to about 80 ng/dl.

8. The skin patch according to claim 7, wherein the testosterone concentration is sufficient for administering testosterone transdermally in an amount from 100 to 300 $\mu\text{g}/\text{day}$.

9. The skin patch according to claim 7 or 8, wherein the polymeric carrier is a pressure sensitive adhesive.

10. The skin patch according to any one of claims 7 to 9, wherein the matrix layer further comprises a permeation enhancer.

11. The skin patch according to claim 7, wherein the polymeric carrier is a polyacrylate adhesive, the matrix layer further comprises a permeation enhancer which is sorbitan monooleate, and wherein the backing layer comprises polyethylene.

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12. The skin patch according to claim 7, wherein the matrix layer further comprises an estrogen concentration sufficient for administering estrogen transdermally in an amount of estrogen equivalent to about 25 to about 200 $\mu\text{g/day}$ of 17β -estradiol, thereby resulting in an estrogenic activity level in the woman equivalent to a 17β -estradiol blood level of about 25 to about 200 pg/ml.

13. The skin patch according to claim 12, wherein the estrogen is 17β -estradiol.

14. A pharmaceutical composition for transdermally administering testosterone to a woman in need of testosterone replacement therapy comprising:

- (a) a transdermal carrier and;
- (b) an amount of testosterone which is sufficient to transdermally administer an amount of testosterone from 50 to 500 $\mu\text{g/day}$ of testosterone, thereby causing blood levels of testosterone in the woman to be from about 15 to about 80 ng/dl.

15. A composition according to claim 14, wherein the transdermal carrier is a polymeric carrier.

16. A composition according to claim 15, wherein the polymeric carrier is a polyacrylate adhesive.

17. A composition according to any one of claims 14 to 16, further comprising a permeation enhancer.

18. A composition according to claim 17, wherein the permeation enhancer is sorbitan monooleate.

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19. A composition according to claim 14, wherein the transdermal carrier is a polyacrylate adhesive and wherein the composition further comprises a permeation enhancer which is sorbitan monooleate.

20. A composition according to any one of claims 14 to 19, wherein the composition further includes an estrogen concentration sufficient for administering estrogen transdermally in an amount equivalent to about 25 to about 200 $\mu\text{g/day}$ of 17β -estradiol, thereby resulting in an estrogenic activity level in the woman equivalent to a 17β -estradiol blood level of about 25 to about 200 pg/ml.

21. A composition according to claim 20, wherein the estrogen is 17β -estradiol.

