# Preparation and Clinical evaluation of Finastride gel in the treatment of idiopathic Hirsutism

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**Abstract:**

**Objective**:

Hirsutism is the presence of excess terminal hairs in females in a male-like pattern. The most accepted hypothesis for the development of hirsutism is increased 5-α reductase activity in hair follicles of hirsute women. Finasteride partially blocks the conversion of testosterone to dihydrotestosterone through inhibition of 5α - reductase in hair follicles. This study was designed to determine the efficacy of finasteride gel 0.25% in management of idiopathic hirsutism and treatment of hirsutism with topical finasteride to lessen the side effects.

**Methods**:

Women after puberty that have idiopathic hirsutism criteria are divided randomly in 2 groups; treatment and control. The number of patients in each group is 15 and received finasteride and placebo gel once a day on their skins. The patients were visited every month by dermatologist and the amount of response to the treatment and the patient satisfaction was recorded. Ferriman–Gallwey score of the treated area was determined.

**Results**:

After 6-month, mean thickness hairs in treating group were decreased from 102.00 ± 9.58 μm to 86.4±11.4 μm ( $p < 0.05$ ),this difference was statistically significant. Gel application did not indicate any type of side effects.

**Limitations:**

Inclusion and exclusion criteria

**Conclusion**:

Finasteride partially blocks 5α - reductase. Because of the good absorption through the skin and good solubility of this medicine, the prepared gel formulation applied on the hirsutism area showed a significant decrease in hair growth locally, so finasteride gel is an efficient and harmless therapy in patients with idiopathic hirsutism.

**Keywords:**

Finastride, Idiopathic hirsutism, Testosterone

## 1. Introduction

Hirsutism is the presence of excess body or facial terminal hair growth in females in a male-like pattern, and affects 5–15% of women depending on definition[1]. Hirsutism is often regarded as a purely aesthetic problem but its medical importance is highlighted by the high prevalence of androgen excess disorders reported among hirsute women[2]. Although there are objective methods of assessing the extent of hirsutism, the perception and impact of excess body hair in an individual woman depends not only on its extent and severity but also on social and cultural influences[3]. Quality of life studies have indicated that severe hirsutism has a serious adverse effect on social interactions and that affected women have a high incidence of depressive symptoms[4-6]. A commonly used method to grade hair growth is a modified scale of Ferriman and Gallwey. A score of eight or more has been considered to represent hirsutism[7].Sex steroids and a number of local and systemic factors can act directly and indirectly on the dermal papilla to regulate hair growth. In response to the increased levels of androgens at puberty, vellus follicles in specific areas develop into terminal hairs[8, 9]. Androgens increase hair follicle size, hair fibre diameter, the proportion of time terminal hairs spend in the anagen phase and sebum secretion. Therefore, not only androgen action alters the type of present hair, but also they will increase the oiliness of skin and hair[9, 10].

Hirsutism is a sign of increased androgen action on hair follicles, from increased circulating levels of androgens (endogenous or exogenous) or increased sensitivity of hair follicles to normal levels of circulating androgens. The severity of the hirsutism does not directly correlate with the level of androgen plasma concentration, because the response of the androgen-dependent follicles to excess amount of androgen was considerably varies between individuals[8, 11].

The term idiopathic hirsutism has been used to describe the circumstance in which hirsutism is present with circulating androgen levels within the normal range[9]. Nearly all hirsute women have an increased in androgens, usually testosterone, but the increase may not be sufficient to raise the serum total testosterone concentration above the normal range because the carrier protein for testosterone, sex hormone-binding globulin, is suppressed when androgen production is increased. In the remaining women, the hirsutism may be due to increased conversion of testosterone to dihydrotestosterone by the enzyme 5α-reductase in peripheral tissue, including hair follicles which this metabolite is more potent than testosterone [12-17]. Thus, elevated 5a-reductase activity has been demonstrated in the hair follicles of women with idiopathic hirsutism, and excess hair growth is likely to be due to an exaggerated response of the hair follicle to normal androgen levels[18]. Nearly all circulating testosterone is bounded to sex hormone binding globulin and albumin, with free testosterone being the most biologically active form[11].

Different medical therapies, alone and in combination have been used to treat idiopathic hirsutism. Oral contraceptives and antiandrogen therapy such as spironolactone, cyproterone acetate and flutamide inhibits ovarian or adrenal androgen production and androgen activity either by blocking androgen cytochrome P450 receptors or by inhibiting 5α- reductas activity. In addition cosmetic hair removing procedures (camouflage by bleaching and various mechanical ways such as shaving, plucking and using depilatory creams) achieve the desired result for only a brief period [19, 20].

Finasteride is a 5α-R inhibitor which can be used systemic or local. Finasteride decreases hair growth by causing less exposure of hair follicles to androgen stimulation[21, 22]. Although the efficacy of systemic finasteride has been reported in different studies, there is a few articles in which the efficacy and tolerability of topical gel of finasteride has been evaluated. The aim of this study was to examine the efficacy and tolerability of topical finasteride in female with idiopathic hirsutism.

## 2. Materials and Methods

### 2.1. Materials

Hydroxy propyl methyl cellulose (HPMC) and sodium carboxy methyl cellulose (CMC) were purchased from Pastor chemical company (Japan). Sodium hydroxide (NaOH), potassium dihydrogen phosphate ($KH_2PO_4$), methyl paraben and propylene glycol were purchased from Merck (Germany). Finasteride was provided by Iran hormone pharmaceutical company (Tehran, Iran), ethanol and dialysis membrane were purchased from Touba azma (Tehran, Iran).

### 2.2. Clinical study

A double blind and randomized study which is controlled by dermatologist in comparison to placebo gel have been done for 6 months

The inclusion and exclusion criteria for the subject selection are presented at the following:

1. Ferriman-Gallwey Score > 8 [7]
2. Normal serum androgen (total testosterone, free testosterone, androstenedione and DHEA-S)
3. Normal serum level of thyroid hormone, prolactin and cortisol.
4. No chemical or biochemical evidence of polycystic ovarian syndrome which is ruled out by regular menstrual cycles, normal ultrasound exam, and serum LH/FSH ratio < 1 and normal serum SHBG.
5. Normal basal and ACTH-stimulated serum 17-hydroxyprogestrone level.
6. Absence of chronic renal disease, diabetes mellitus and hepatic disease.
7. The subjects that did not use any other drugs for treatment of hirsutism

The selected women after signing a written consent are divided randomly in 2 groups; treatment group (with finasteride) and control group (with placebo). The number of patients in each group was 15.

This study was approved by the ethical committee of Kermanshah University of medical sciences. All the patients were informed consent for their participation in our study after reading the protocol of this experiment. They were informed that finasteride could affect a male fetus and consequently pregnancy was contraindicated during the treatment and so effective contraceptive must be used. They were also informed that potential side effects of finasteride were unknown in women and they should report any possible side effects during the medication. The patients were explained not to use any other drug for idiopathic hirsutism at the same time. Moreover electrolysis, waxing and plucking were not permitted during the treatment whereas shaving was permitted for subjective evaluation of hair growth by patients. The degree of hirsutism in the skin area was determined by Ferriman-Gallwey score. The scale is from 0 (absence of terminal hairs) to 4 (extensive terminal hair growth). Premature scores were determined by 2 examiners and mean scores were calculated for each patients.

Three hairs of the skin area were plucked from each patient. Each hair was then fixed on a slide with a transparent resin that solidifies with air and was covered with another slide. Hair caliber was measured with a micrometer applied to an optical microscope (x 10 magnificence). Then they received finasteride gel 0.25% on their skins once a day for 6 months. They were explained to clean the skin area before usage and to avoid using powder, lotions, and sprays three hours after gel.
The patients were seen in consultation at 1 month's intervals. Questions were asked about the side effects, menstrual abnormalities and also patients self-evaluation of the clinical effects of the treatment. After six months rate of hair growth of the skin area, the mean caliber of three plucked hairs and the Ferriman-Gallwey score of the skin area was evaluated.

2.3. Statistical analyses

Data are presented as mean ± SD or percentage. Statistical analyses were performed using spss software version 16:0:0 and paired T-Test for comparison of quantitative variables was used to compare the hair caliber before and after medication. P values less than 0.05 were statistically significant.

2.4. Preparation of Finastride gel

According to previous studies related to clinical effect of finasteride on hirsutism, for preparing finasteride gel 0.25%, pure finasteride was used. hydroxy propyl methyl cellulose and sodium carboxymethyl cellulose as Polymers gel formulations was used by the specified amount. Propylene glycol as wetting agent and ethanol as cosolvent for finasteride and methyl paraben as a preservative agent was used.15 gr aluminum tube was selected as an appropriate package. The placebo gel consisted of the derma base alone in the same size and type of tube. No difference in color or texture was evident between the placebo and medication containing gels.

2.5. Physicochemical and microbial stability tests

To study the chemical and physical stability of the formulation, pharmaceutical products was placed at 40 ° C and 70% humidity in the germinator and each month for viscosity, color, and amount of drug was studied. Microbial and preservative effectiveness testing was based on the United States Pharmacopoeia guidelines.

2.6. In vitro Evaluation of drug release

2.6.1. Preparation of solutions

Isotonic phosphate buffered saline pH 5.75 (PBS-buffer) was prepared by dissolving 1.36 g $KH_2PO_4$ and 0.028g NaOH in 200 ml distilled water. PBS-buffer was used as the receptor solution.

2.6.2. Experiments with Franz diffusion cells

Franz diffusion cell with a volume of 78 ml was used for the drug release evaluation. The Franz diffusion cell consisted of a donor and receptor compartment .The membrane was mounted between the cell compartment and an O-ring was used to position the membrane. The two cell compartments were held together with a clamp. The temperature of Franz diffusion cell chamber was adjusted to

37°C by a water bath circulation and 1g of gel was applied to the cell that was put on dialysis membrane. The receptor solution was continuously stirred by means of a spinning bar magnet, at 200rpm. 2.0 ml aliquots were withdrawn through the sampling port of the receptor compartment at specified time intervals. The cells were refilled with receptor solution to keep the volume of receptor solution constant during the experiment. The experiments were run for 3 hours. Sample absorbance was read by a spectrophotometer at a wavelength of 210 nm. The linearity of calibration curve with concentration range from 0.6125-10 µg/ml and linear equation "y = 0.1669x – 0.0196" has been verified. The drug release profiles of the drug formulations were plotted according to the calibration curve.

## 3. Results

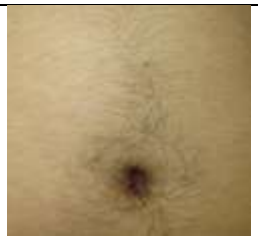
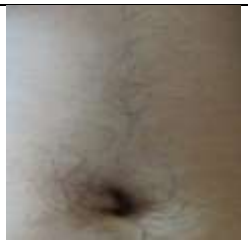
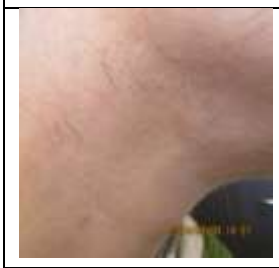
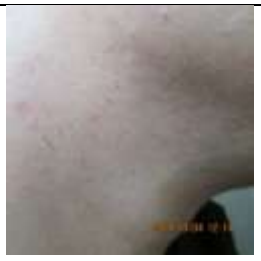
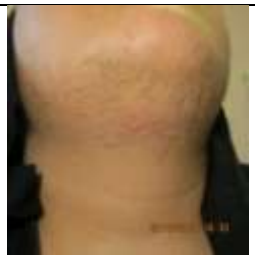
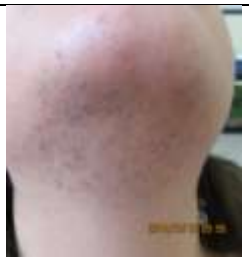
3.1. Patient compliancy

None of the women reported any problems with irregularity of menstrual periods, changes in libido, and changes in energy level, nausea, vomiting, diarrhea, abdominal pain, or headache. Allergic reaction to the medication or skin eruption in the areas in which the gels were applied was observed in one patient. All of the patients showed a good compliancy related to the finasteride gel application and there were no incompliance report about the viscosity, odor, color and filling during remaining time of gel on the skin.

3.2. Clinical effects

All of the patients in treating group noted a considerable diminished rate of hair growth on the areas in which the gel were applied (at least fewer times needed for shaving) and hair follicles became looser and easier to pluck, but patients in placebo group didn't mention any difference rate of hair growth. The pictures of some patients before and after treatment are showed in figure 1.

**Severity of hirsutism after 6 months treatment with 0.25% finastride gel**

| Before | After | Before | After |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |

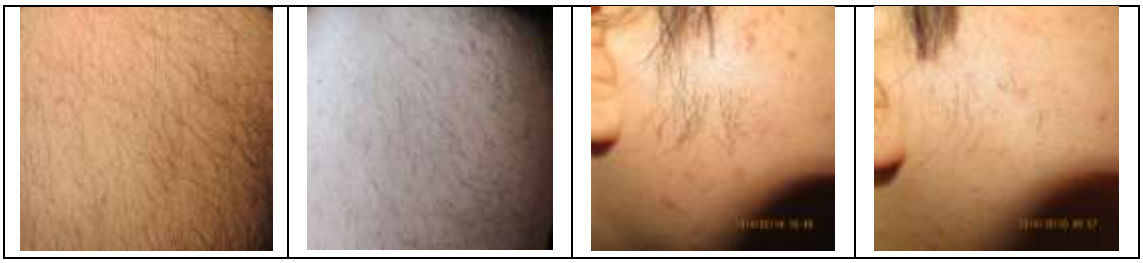


**Fig. 1: Severity of hirsutism after 6 months treatment with 0.25% finastride gel**

Hair thickness in treating group, before and after treatment are showed in table 1 and table 2 and hair thickness in placebo group, before and after treatment are showed in table 3 and table 4. Comparison Chart for mean thickness hairs before and after six months in both groups are shown in Figures 2 and 3.

**Tab 1. Hair thickness (mm) – before treatment in treating group**

| Hair thickness (mm) | | | | | | |
|---|---|---|---|---|---|---|
| **Number** | **Hair 1** | **Hair 2** | **Hair 3** | **Average** | **SD** | **% CV** |
| 1 | 0.07 | 0.1 | 0.09 | 0.086667 | 0.015275 | 17.62529 |
| 2 | 0.11 | 0.11 | 0.11 | 0.11 | 0 | 0 |
| 3 | 0.08 | 0.07 | 0.07 | 0.073333 | 0.005774 | 7.872958 |
| 4 | 0.12 | 0.11 | 0.11 | 0.113333 | 0.005774 | 5.094267 |
| 5 | 0.08 | 0.1 | 0.09 | 0.09 | 0.01 | 11.11111 |
| 6 | 0.1 | 0.08 | 0.08 | 0.086667 | 0.011547 | 13.32347 |
| 7 | 0.12 | 0.11 | 0.1 | 0.11 | 0.01 | 9.090909 |
| 8 | 0.1 | 0.1 | 0.13 | 0.11 | 0.017321 | 15.74592 |
| 9 | 0.12 | 0.11 | 0.1 | 0.11 | 0.01 | 9.090909 |
| 10 | 0.1 | 0.11 | 0.11 | 0.106667 | 0.005774 | 5.412659 |
| 11 | 0.11 | 0.11 | 0.11 | 0.11 | 0 | 0 |
| 12 | 0.08 | 0.08 | 0.1 | 0.086667 | 0.011547 | 13.32347 |
| 13 | 0.08 | 0.08 | 0.07 | 0.076667 | 0.005774 | 7.530656 |
| 14 | 0.12 | 0.1 | 0.11 | 0.11 | 0.01 | 9.090909 |
| 15 | 0.11 | 0.12 | 0.08 | 0.103333 | 0.020817 | 20.14515 |
| Average | | | | 0.102 | 0.00958 | 14.05297 |

**Tab 2.Hair thickness (mm) –after treatment in treating group**

| Hair thickness (mm) | | | | | | |
|---|---|---|---|---|---|---|
| **Number** | **Hair 1** | **Hair 2** | **Hair 3** | **Average** | **SD** | **% CV** |
| 1 | 0.06 | 0.05 | 0.05 | 0.0533 | 0.0058 | 10.8253 |
| 2 | 0.09 | 0.1 | 0.11 | 0.1000 | 0.0100 | 10.0000 |
| 3 | 0.06 | 0.06 | 0.06 | 0.0600 | 0.0000 | 0.0000 |
| 4 | 0.1 | 0.13 | 0.07 | 0.1000 | 0.0300 | 30.0000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 0.09 | 0.09 | 0.08 | 0.0867 | 0.0058 | 6.6617 |
| 6 | 0.06 | 0.08 | 0.1 | 0.0800 | 0.0200 | 25.0000 |
| 7 | 0.09 | 0.1 | 0.11 | 0.1000 | 0.0100 | 10.0000 |
| 8 | 0.06 | 0.08 | 0.07 | 0.0700 | 0.0100 | 14.2857 |
| 9 | 0.1 | 0.1 | 0.1 | 0.1000 | 0.0000 | 0.0000 |
| 10 | 0.08 | 0.08 | 0.11 | 0.0900 | 0.0173 | 19.2450 |
| 11 | 0.07 | 0.09 | 0.11 | 0.0900 | 0.0200 | 22.2222 |
| 12 | 0.11 | 0.13 | 0.09 | 0.1100 | 0.0200 | 18.1818 |
| 13 | 0.1 | 0.1 | 0.09 | 0.0967 | 0.0058 | 5.9726 |
| 14 | 0.12 | 0.11 | 0.11 | 0.1133 | 0.0058 | 5.0943 |
| 15 | 0.08 | 0.09 | 0.11 | 0.0933 | 0.0153 | 16.3663 |
| Average | | | | 0.0896 | 0.0117 | 12.9237 |

After 6-month, mean thickness hairs in treating group were decreased from 102.00 ± 9.58 µm to 86.4±11.4 µm ( $p < 0.05$ ),this difference was statistically significant.

After 6-month, mean thickness hairs in placebo group were decreased from 98.22 ± 22.32 µm to 96.88±20.75 µm ($p < 0.05$ ),this difference was not statistically significant.

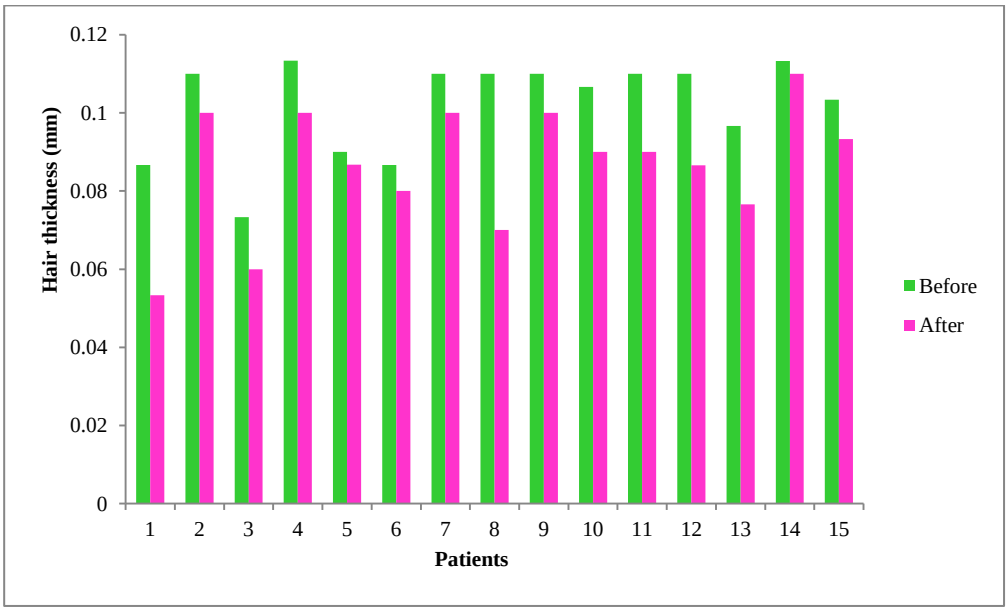



**Fig 2. Comparison Chart for mean thickness hairs before and after six months in treating group**

**Tab 3. Hair thickness in placebo group, before treatment**

| Hair thickness (mm) - Before | | | | | | |
|---|---|---|---|---|---|---|
| **Number** | **Hair 1** | **Hair 2** | **Hair 3** | **Average** | **SD** | **% CV** |
| 1 | 0.03 | 0.03 | 0.02 | 0.026667 | 0.005774 | 21.65064 |
| 2 | 0.11 | 0.1 | 0.14 | 0.116667 | 0.020817 | 17.84285 |
| 3 | 0.1 | 0.09 | 0.1 | 0.096667 | 0.005774 | 5.972589 |
| 4 | 0.08 | 0.09 | 0.09 | 0.086667 | 0.005774 | 6.661734 |
| 5 | 0.11 | 0.1 | 0.11 | 0.106667 | 0.005774 | 5.412659 |
| 6 | 0.1 | 0.08 | 0.09 | 0.09 | 0.01 | 11.11111 |
| 7 | 0.12 | 0.12 | 0.1 | 0.113333 | 0.011547 | 10.18853 |
| 8 | 0.1 | 0.09 | 0.13 | 0.106667 | 0.020817 | 19.51562 |
| 9 | 0.11 | 0.11 | 0.09 | 0.103333 | 0.011547 | 11.17452 |
| 10 | 0.1 | 0.08 | 0.11 | 0.096667 | 0.015275 | 15.80199 |
| 11 | 0.1 | 0.11 | 0.13 | 0.113333 | 0.015275 | 13.47816 |
| 12 | 0.12 | 0.09 | 0.1 | 0.103333 | 0.015275 | 14.7825 |
| 13 | 0.08 | 0.9 | 0.11 | 0.093333 | 0.015275 | 16.36634 |
| 14 | 0.14 | 0.11 | 0.12 | 0.123333 | 0.015275 | 12.38534 |
| 15 | 0.09 | 0.12 | 0.08 | 0.096667 | 0.020817 | 21.53448 |
| Total average | | | | 0.098222 | 0.02232 | 22.72441 |

**Tab 4. hair thickness in placebo group, after treatment**

| Hair thickness (mm) - After | | | | | | |
|---|---|---|---|---|---|---|
| **Number** | **Hair 1** | **Hair 2** | **Hair 3** | **Average** | **SD** | **% CV** |
| 1 | 0.03 | 0.03 | 0.03 | 0.03 | 0 | 0 |
| 2 | 0.12 | 0.11 | 0.1 | 0.11 | 0.01 | 9.090909 |
| 3 | 0.11 | 0.09 | 0.1 | 0.1 | 0.01 | 10 |
| 4 | 0.08 | 0.1 | 0.09 | 0.09 | 0.01 | 11.11111 |
| 5 | 0.11 | 0.1 | 0.12 | 0.11 | 0.01 | 9.090909 |
| 6 | 0.08 | 0.08 | 0.07 | 0.076667 | 0.005774 | 7.530656 |
| 7 | 0.08 | 0.13 | 0.12 | 0.11 | 0.026458 | 24.05228 |
| 8 | 0.11 | 0.1 | 0.12 | 0.11 | 0.01 | 9.090909 |
| 9 | 0.1 | 0.12 | 0.09 | 0.103333 | 0.015275 | 14.7825 |
| 10 | 0.11 | 0.09 | 0.11 | 0.103333 | 0.011547 | 11.17452 |
| 11 | 0.12 | 0.08 | 0.11 | 0.103333 | 0.020817 | 20.14515 |
| 12 | 0.1 | 0.11 | 0.08 | 0.096667 | 0.015275 | 15.80199 |
| 13 | 0.08 | 0.1 | 0.11 | 0.096667 | 0.015275 | 15.80199 |
| 14 | 0.12 | 0.11 | 0.11 | 0.113333 | 0.005774 | 5.094267 |
| 15 | 0.08 | 0.12 | 0.1 | 0.1 | 0.02 | 20 |
| Total average | | | | 0.096889 | 0.020758 | 21.42466 |

After 6-month, mean thickness hairs in placebo group were decreased from 98.22 ± 22.32 µm to 96.88±20.75 µm ($p < 0.05$ ),this difference was not statistically significant.

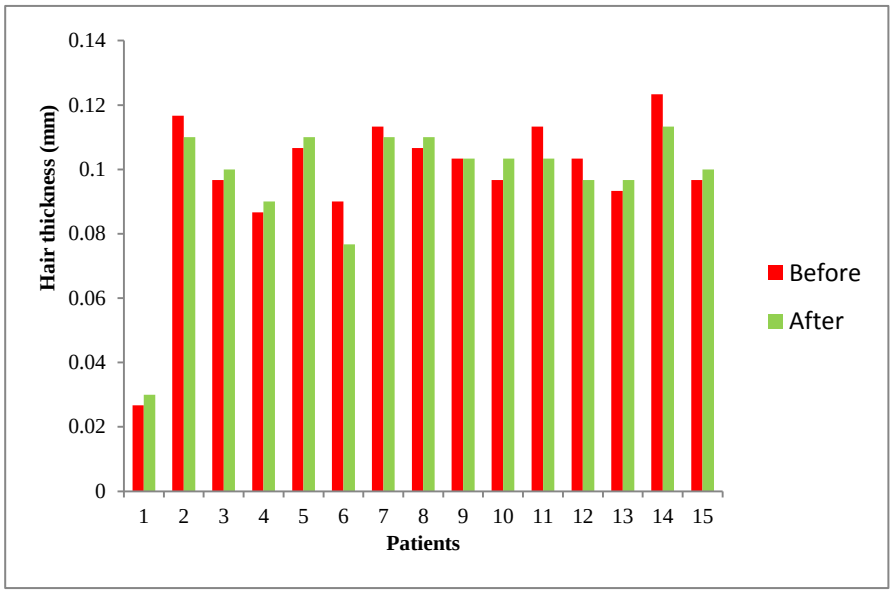



**Fig 3. Comparison Chart for mean thickness hairs before and after six months in placebo group**

3.3. In vitro drug release

Sample absorbance was read by a spectrophotometer at a wavelength of 210 nm. The linearity of calibration curve with concentration range from 0.6125-10 µg/ml has been proved. The drug release profiles of the drug formulations were plotted according to the calibration curve. The percent of drug release can be seen in table 5 and figure 4.

**Tab 5. The percent of drug release from finastride gel**

| Time (min) | Absorbtion | Concentration (µg/ml) | Q* in 78 cc (µg) | Release (%) |
|---|---|---|---|---|
| 15 | 0.068 | 5.248 | 409.39 | 16.37 |
| 30 | 0.203 | 13.337 | 1040.31 | 41.61 |
| 45 | 0.254 | 16.393 | 1278.65 | 51.14 |
| 60 | 0.294 | 18.789 | 1465.59 | 58.62 |
| 75 | 0.315 | 20.047 | 1563.73 | 62.54 |
| 90 | 0.348 | 22.025 | 1717.96 | 68.71 |
| 105 | 0.360 | 22.744 | 1774.04 | 70.96 |
| 120 | 0.385 | 24.242 | 1890.88 | 75.63 |
| 135 | 0.403 | 25.321 | 1975.00 | 79.00 |
| 150 | 0.411 | 25.799 | 2012.39 | 80.49 |
| 165 | 0.414 | 25.979 | 2026.41 | 81.05 |
| 180 | 0.417 | 26.159 | 2040.43 | 81.61 |

* The amount of drug

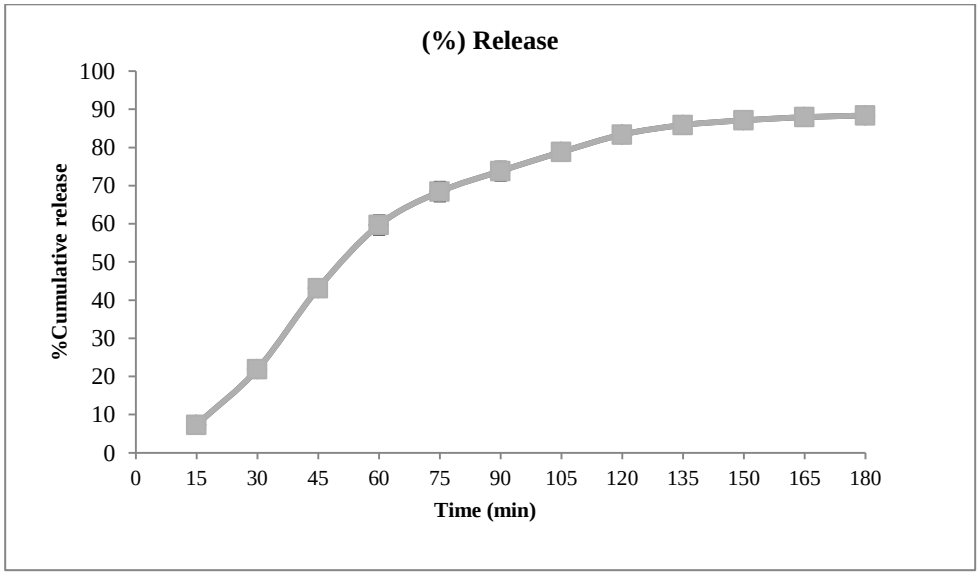



**Fig 4. Curves of cumulative percentage drug release**

## 4. Discussion

Hyperactivity of 5α- reductase in the skin is considered a major mechanism of excessive hair growth in hirsute women with normal levels of serum androgens. Androgens increase hair follicle size, hair fiber diameter, the proportion of time terminal hairs spend in the anagen phase and sebum secretion. Therefore, not only androgen action alters the type of present hair, but also they will increase the oiliness of skin and hair, since finasteride is a 5α- reductase inhibitor, with no androgenic, anti-androgenic, steroid hormone-related properties and affinity for androgen receptors, the use of finasteride for the treatment of hirsutism is rational because of its specific effect on 5α - reductase, the enzyme responsible for sensitizing the hair to testosterone [22-26]. In previous studies, orally administered finasteride has been successfully used in the treatment of hirsutism but have major side effects [27-29]. Notably there have been fewer investigations about topical application of finasteride. In fact its effects as a topical drug in the treatment of hirsutism are still debated, so this study was designed to determine the efficacy of finasteride gel 0.25% in management of idiopathic hirsutism and treatment of hirsutism with topical finasteride to lessen the side effects. Because the majority of patients with hirsutism have oily skin, oily base used for production pharmaceutical formulations may cause unpleasant feeling on the skin and can even lead to acne. So usage of the water-based gel formulations, in addition to the lack of acne it is more suitable for washing and cleansing of the skin, and have greater acceptance by patients. *Heydari et al*, Forty women with idiopathic hirsutism received finasteride cream 0.25% twice a day for 6 months on their chins and reported that acne was reported by 8 patients (20%) during the therapy[30], while in this study gel application, acne was not reported by patients. In a previous study, *Lucas* showed a significant reduction in mean hair counts and the thickness of the hairs in eight women with hirsutism that treated with finasteride cream 0.25%

[22], in other study *Heydari et al* indicated that mean hair thickness and mean *Ferriman –Gallwey* score were decreased [30] and Our study confirms the results of these two studies.

## 5. Conclusions

The current study, designed to assess the clinical effects of finasteride gel on hirsutism, showed significant improvement in the area treated by topically applied finasteride.

In our study no adverse effect except rash in one person was reported. This indicates that topical finasteride is a promising therapy for idiopathic hirsutism with less side-effect in comparison with orally administered one.

In this study, hair follicles became looser and easier to pluck. These effects helped the patients to have fewer problems with their hirsutism, as they managed to pluck hairs in longer intervals. One of the most important reasons for patient satisfaction from this dosage form was reduction in shaving time.

## 6. Acknowledgment

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