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TrichoScan as a Method to Determine Hair Root Pattern in Patients with Scalp Psoriasis

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SUMMARY Scalp involvement is a prominent and often the initial presentation in patients with psoriasis. Hair growth may be impaired with a hair loss and an increased telogen/anagen ratio. The aim of this study was to investigate the hair density and anagen/telogen ratio in psoriatic patients, using epiluminescence microscopy combined with digital image analysis (TrichoScan). Thirty psoriatic patients with scalp involvement and the same number of clinically healthy individuals were included in the study. For the measurement of hair density, anagen/telogen ratio and number of terminal and vellus hairs, a commercially available software TrichoScan was used. Hair density measurements did not show significant difference between patients and controls (P=0.05). The anagen ratio was significantly lower and telogen ratio significantly higher in psoriasis patients than in controls (P<0.01 both). There was no correlation between hair parameters and patient age or duration of disease. Study results support the evidence that scalp psoriasis is associated with an increased telogen/anagen ratio.

KEY WORDS: TrichoScan, scalp psoriasis, hair density, anagen/telogen ratio

INTRODUCTION

Psoriasis is a chronic inflammatory skin disease with a complex immune and genetic background, triggered by environmental factors (1). Scalp involvement is a prominent feature and often the initial presentation. Its severity ranges from discrete involvement with slight, fine scaling to extremely severe disease with crusted plaques covering the entire scalp. Persistent involvement of the scalp can lead to hair loss, development of telogen effluvium (2) and rarely, scarring alopecia (3). On the contrary, there are several reports supporting the thesis that there are no characteristic changes in the hair growth or in the hair follicle kinetics in scalp psoriasis (4,5).

Numerous methods have been described to assess the rate of hair growth. The technique can be classified as invasive (biopsies), semi-invasive (trichogram), or noninvasive (phototrichogram

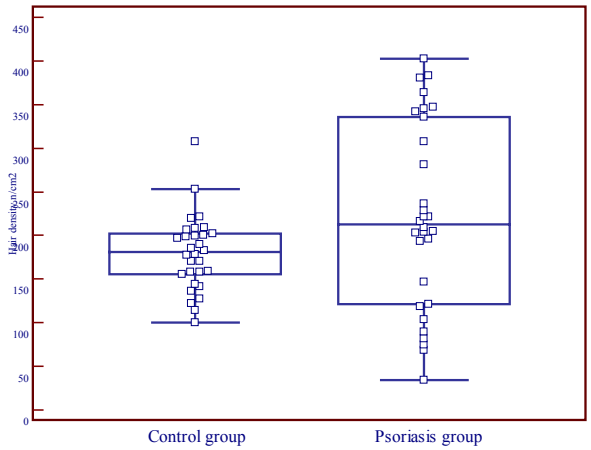

Figure 1. Hair density.

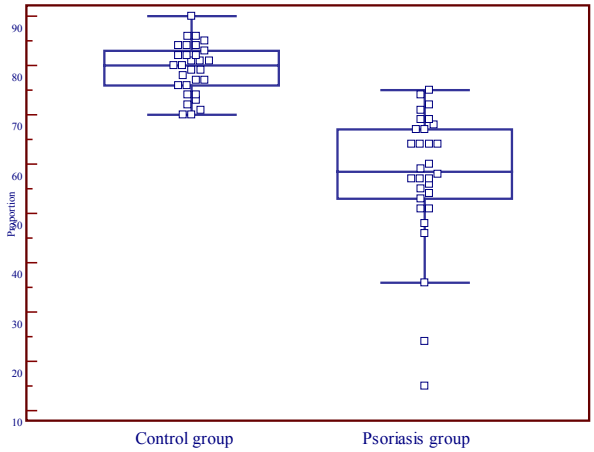

Figure 2. Anagen proportion.

electron microscopy and laser scanning microscopy) methods. A useful method must be able to analyze the biologic parameters of hair growth, which include hair density (n *per* cm^2), hair diameter (nm), hair growth rate (mm *per* day) and anagen/telogen ratio (6). In recent years, epiluminescence microscopy (ELM) has been combined with digital image analysis (TrichoScan) to assess the biologic parameters of hair growth (7) and has been reported to be a valuable tool in measuring hair parameters (8,9).

Literature data on trichogram findings in scalp psoriasis are very limited and results are controversial. The aim of this study was to investigate the hair density and anagen/telogen ratio in psoriatic patients using ELM combined with digital image analysis (TrichoScan).

PATIENTS AND METHODS

Patients

Thirty patients with psoriasis (13 female and 17 male, aged 17-64, median age 37.6) and the same number of clinically healthy individuals (13 female and 17 male, aged 16-65, median age 37.4) were included in the study. All patients with psoriasis had chronic stationary plaque lesions with scalp involvement. No concomitant diseases were recorded. Only individuals that had not used any topical or oral treatment in the previous 2 months were enrolled. Family history and data on the duration and severity of the disease were collected. In all cases, the clinical diagnosis was confirmed by skin/scalp biopsy. All subjects gave their informed consent in accordance with the requirements of the institutional Ethics Committee.

Methods

For the measurement of hair density (n/cm^2) and anagen/telogen ratio, we used TrichoScan as a method that combines standard ELM with automatic digital image analysis. The use of TrichoScan initially involves shaving a scalp area (approximately 1.8 cm^2). The area to be shaved is chosen using the same criteria as for epilation with the classic trichogram technique. After three days, the hairs in the shaven area are dyed and a digital photograph is taken at 20-fold magnification.

Statistics

Analysis was carried out by calculating 95% confidence interval (95%CI) for median values of hair density, anagen/telogen ratio and median proportions for anagen and telogen proportions. The distribution of TrichoScan values (hair density, anagen proportion, telogen proportion, anagen/telogen ratio, number of vellus and terminal hairs) were compared between the groups using Mann-Whitney test. Values with $P<0.05$ were accepted as statistically significant. We used the point biserial correlation coefficient (r_{pb}) for analysis of the

Table 1. Demographic data of patients (psoriasis group) and volunteers (control group)

	Psoriasis group n (%)	Control group n (%)	*P*
Men	17 (57%)	17 (57%)	>0.05
Women	13 (43%)	13 (43%)	>0.05
Age range (yrs)	17-64	16-65	>0.05
Age, mean (SD) (yrs)	37.63 (14.09)	37.40 (13.57)	>0.05

Table 2. Results of digital image analysis

Hair parameter	Psoriasis group		Control group			
	Median	95% CI	Median	95% CI	Z statistic	*P* for Mann-Whitney test
Hair density (n/cm^2)	212.40	193.76-273.17	180.75	158.76-199.24	-1.90	0.0575
Anagen proportion (%)	58.50	55.18-64.00	80.00	77.00-82.00	6.37	<0.01
Telogen proportion (%)	41.50	36.00-44.83	20.00	18.00-23.00	-6.37	<0.01
Anagen/telogen ratio	1.41	1.23-1.78	4.00	3.35-4.56	6.37	<0.01
Velus hairs (n/cm^2)	7.80	3.64-8.70	2.60	1.70-4.16	-2.96	<0.01
Terminal hairs (n/cm^2)	210.20	184.13-258.62	177.70	153.56-197.25	-1.69	0.0905

relationship between dichotomous variable (psoriasis or control) and continuous variable (proportion of anagen hairs, ratio of anagen/telogen hairs, hair density (n/cm^2) and density of vellus hairs (n/cm^2). Statistical significance was set at $P<0.05$.

Statistical analyses were performed using MedCalc for Windows, version 11.1.0.0 (MedCalc Software, Mariakerke, Belgium).

RESULTS

We performed a cross-sectional study in 30 consecutive outpatients with scalp psoriasis and 30 age- and sex-matched controls. Demographic data of patients and controls are shown in Table 1. The mean (±SD) age of the patient and control groups was 37.6±14.0 and 37.4±13.5, respectively ($P=0.9481$). Family history was positive for psoriasis in five of 30 (16.6%) patients. The duration of scalp psoriasis ranged from 3 to 267 months.

Mann-Whitney test did not yield significant difference in hair density (n/cm^2) between the psoriasis group (PG) (Md=212.40, n=10, 95% CI=193.76-273.17) and control group (CG) (Md=180.75, n=30, 95%CI=158.76-199.24), z=-1.90, $P=0.0575$ (Table 2, Fig. 1). A statistically significant difference was found in anagen proportion between PG (Md=58.50, n=30, 95% CI=55.18-64.00) and CG (Md=80.00, n=30, 95% CI=77.00-82.00), z=6.37, $P<0.01$) (Table 2, Fig. 2). The same statistically significant differences were found in telogen proportion and anagen/telogen ratio (Table 2, Figs. 3 and 4). Between-group difference in the number of vellus hairs *per* cm^2 was significantly different: PG (Md=7.80, n=30, 95% CI=3.64-8.70) and CG (Md=2.60, n=30, 95%CI=1.70-4.16) z=-2.96, $P<0.01$ (Table 2). There was no significant difference in the number of terminal hairs (n/cm^2) between PG (Md=210.20, n=30, 95%CI=184.13-258.62) and CG (Md=177.70, n=30, 95%CI=153.56-197.25), z=1.69, $P=0.0905$ (Table 2).

Test point biserial coefficient of correlation showed that a smaller proportion of anagen hairs correlated strongly (r=-0.7298, $P<0.0001$) with scalp psoriasis. A similar result was recorded for the ratio of anagen/telogen hairs (r=-0.7588, $P<0.0001$). The same test showed that more vellus hairs correlated moderately (r=0.4339, $P=0.0005$) and high density of hairs weakly (r=0.2541, $P=0.0501$) with scalp psoriasis.

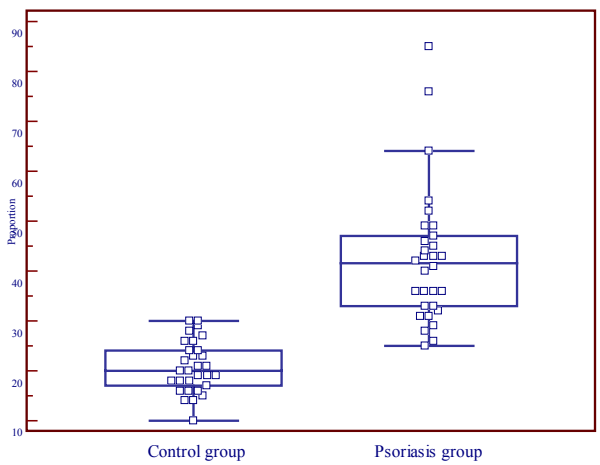

Figure 3. Telogen proportion.

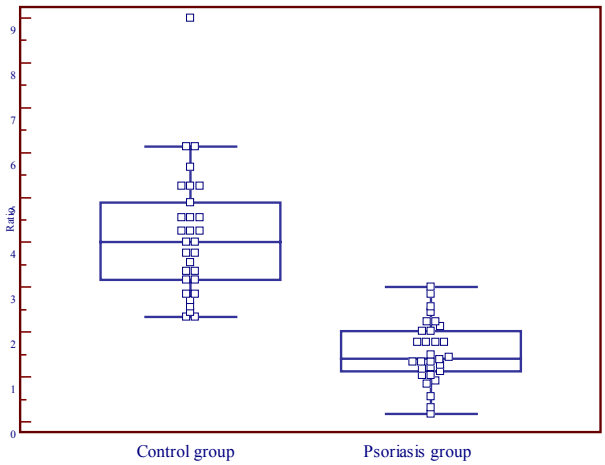

Figure 4. Anagen/telogen ratio.

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DISCUSSION

The scalp is the most commonly affected site in psoriasis, being involved in 50%-80% of cases, and can often be the sole site of involvement (10). This condition may appear at any age and any part of the scalp can be involved. The histopathologic features include follicular plugging, enlargement of the follicular ostia, and follicular parakeratosis. In scalp psoriasis, the lower outer root sheath and hair matrix are not affected by psoriatic changes, although there is an irregular expansion in the proximal lower outer root sheath (11). Scanning electron microscopy study of scalp hair from psoriatic lesions has revealed dystrophic changes in hair cuticle cells (12). Despite the increased epidermal proliferation and reduced transit time, the rate of hair growth is not increased. However, the caliber of hairs from within a plaque is reduced and the cuticles are ruffled.

The hairs involvement in scalp psoriasis is not completely understood. This could be due to inflammatory or mechanical changes. Histologically, a patchy perifollicular infiltrate was found, which tended to be adnexotropic (13). This infiltrate probably cuts short the grow phase causing earlier telogen formation. In their study, Orfanos and Frost observed an increased number of dysplastic hair shafts, a diminished number of anagen hairs and insignificantly increased telogen ratio (14). Runne and Kroneisen-Wiersma examined 47 patients with psoriatic alopecia (13). Alopecia developed after the onset of scalp psoriasis and only in the areas affected by psoriasis. The authors examined trichograms of 29 patients from the area of alopecia as well as from the border of the lesions and from clinically uninvolved areas. In 13 cases, the telogen rate was pathologically elevated, in those with acute hair loss up to 63% (25%-86%), and in those with chronic hair loss up to 36% (29%-44%). They considered the possibility that the strong attachment of hair to the scalp by scales impeded the ability of the hair shaft to move outside the follicle, causing a permanent pressure on the root. This phenomenon might then disturb the normal growth cycle causing earlier telogen formation. Stanimirovic *et al.* have described the increasing proportion of dysplastic hair shafts, and slightly increased telogen ratio in scalp psoriasis (15). Later on, Bardazzi *et al.* have reported on four patients affected by psoriatic scarring alopecia (3). The histopathologic features included inflammatory infiltrates around the infundibular and isthmic areas.

According to our results, telogen hairs in scalp psoriasis were statistically significantly more frequent as compared with the control group. These results are consistent with a clinical study performed by Schoorl *et al.* (2). They carried out a study in 22 psoriatic patients and controls, which showed a consistent increase in the percentages of telogen and catagen hair in psoriatic plaques compared with those in uninvolved areas and normal controls.

Unexpectedly, hair density was lower in the control group than in the patient group; however, the difference was not statistically significant. The relatively low hair density in our control group may be attributed to the characteristics of our study group, although Sawan and Descamps also report an increased density of hair in psoriatic plaque (16). The authors suggest that scalp psoriasis may be caused by an increase in the recruitment of stem cells, resulting in a switch-on in the anagen phase.

CONCLUSION

In conclusion, the present study supports the evidence that scalp psoriasis is associated with hair loss and an increased telogen/anagen ratio. The significantly increased telogen ratio indicated disturbance of hair root. This could be due to inflammatory or mechanical changes. Additional studies may help in the understanding of the pathogenesis of the disease.

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