

DETERMINATION OF THE EPILATION FORCEShanmuga Sundaram¹, Kumaresan M², Srinivas C. R³¹Associate Professor, Department of Dermatology, Karpagam Medical College, Coimbatore, Tamilnadu, India.²Dermatologist, Department of Dermatology, Cutis Skin Clinic, Coimbatore, Tamilnadu, India.³Dermatologist, Department of Dermatology, Rangas Skin Clinic, Coimbatore, Tamilnadu, India.**ABSTRACT****BACKGROUND**

Hair loss is a common problem encountered either due to pathological causes or nutritional deficiencies. Trichotillometer is a device that is used to determine the force required to pluck the hair. Trichotillometer is not available commercially. We wanted to determine the epilation force (EF) required to pluck the anagen hair and telogen hair from four regions (frontal, vertex, occipital and parietal) of the scalp.

MATERIALS AND METHODS

Ten healthy volunteers who did not complain of hair loss were studied. The EF required to pluck hair from 4 regions (frontal, vertex, occipital and parietal) on each volunteer was determined using Instron fabric tensile strength tester 6021 (Instron Limited, U. K.). Ten hairs were plucked from each site. The root of the plucked hair was examined under microscope to determine whether the follicle plucked was in the anagen or telogen phase. Subsequently the mean force required to pluck the anagen hair and telogen hair from each area was calculated.

RESULTS

A total of 10 volunteers were included in the study. Among them, five were males and 5 were females. A total of 400 hairs were examined. The mean EF required to pluck the anagen hair was 63.10 gms, and telogen hair was 39.86 gms. In male, the mean EF required to pluck the anagen hair was 73.98 gms and telogen hair was 46.87 gms. In female, the mean EF required to pluck the hair was 52.16 gms for anagen hair and telogen hair was 33.39 gms.

CONCLUSION

Greater force was required to epilate the anagen hairs than the telogen hairs on all the areas of scalp and greater force was required to epilate the anagen and telogen hairs in males than in females.

KEY WORDS

Epilation Force, Anagen Hair, Telogen Hair

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BACKGROUND

Hair loss is a common problem encountered either due to pathological causes or nutritional deficiencies. There are various tests available to investigate the hair loss like, hair pull test, hair pluck test (Trichogram), phototrichogram, digital phototrichogram, unit area trichogram, hair diameter assessment and trichotillometer. Trichotillometer is a device that is used to determine the force required to pluck the hair. Trichotillometer is not available commercially. Instron universal Tensile Strength Tester 6021 (Instron limited, U K) is a machine, used in textile industry to test the tensile strength of textile fibers.¹ This study was planned to utilize Instron to determine the epilation force (EF) required to pluck the hair.

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**Aim of The Study**

To determine the epilation force (EF) required to pluck the anagen hair and telogen hair from four regions (Frontal, vertex, occipital and parietal) of the scalp.

MATERIALS AND METHODS

This is an observational study. Ten healthy volunteers who did not complain of hair loss were studied. The EF required to pluck hair from 4 regions (Frontal, vertex, occipital and parietal) on each volunteer was determined using Instron fabric tensile strength tester 6021 (Instron limited, U K) (Figure 1). The volunteer sat in front of the Instron equipment with the chin placed over the flat surface on the Instron (Figure 2). Each hair was individually attached to the pneumatic side – action grip clamp of Instron and the hair was plucked. The EF was recorded in grams. Ten hair was plucked from each site. The root of the plucked hair was examined under microscope to determine whether the follicle plucked was in the anagen or telogen phase. Subsequently the mean force required to pluck the anagen hair and telogen hair from each area was calculated. Data were analysed using SPSS PC (11.5 version). Mean and standard deviation (SD) were calculated. Z test was done to test the statistical significance. Examination of hair was carried out at standard time (at least 3 days) after the last washing of the hair. Institutional ethics committee approval was obtained for this study project.

RESULTS

A total of 10 volunteers were included in the study among them five were males and 5 were females. A total of 400 hairs were examined. The mean EF required to pluck the anagen hair was 63.10 gms and telogen hair was 39.86 gms (P-value - 0.000). In frontal area the mean EF required to pluck the anagen hair was 69.62 gms and telogen hair was 53.22 gms (P-value -0.128) (Table 1). In vertex area the mean EF required to pluck the anagen hair was 68.30 gms and telogen hair was 38.29 gms (P-value -0.000). In occipital area the

mean EF required to pluck the anagen hair was 57.72 gms and telogen hair was 26.78 gms (P-value-0.000). In parietal area the mean EF required to pluck the anagen hair was 59.31 gms and telogen hair was 26.92 gms (P-value -0.034). In male the mean EF required to pluck the hair anagen hair was 73.98 gms and telogen hair was 46.87 gms (P-value-0.037). In female the mean EF required to pluck the hair was 52.16 gms for anagen hair and telogen hair was 33.39 gms (P-value-0.000) (Table 2).

Region	Phase	Nos.	Mean in gm (SD)	Z-Statistics	p-Value
Total	Anagen	375	63.10 (35.48)	5.441	0.000*
	Telogen	25	39.86 (19.29)		
Frontal	Anagen	92	67.62 (25.43)	1.54	0.128
	Telogen	08	53.22 (25.83)		
Vertex	Anagen	90	68.30 (51.56)	4.41	0.000*
	Telogen	10	38.29 (12.92)		
Occipital	Anagen	96	57.72 (32.80)	7.82	0.000*
	Telogen	04	26.78 (04.22)		
Parietal	Anagen	97	59.31 (25.94)	2.15	0.034*
	Telogen	03	26.92 (05.88)		

Table 1. Epilation Force (EF) for Various Regions of Scalp

Sex	Phase	Nos.	Mean in gm (SD)	Z-Statistics	p-Value
Male	Anagen	188	73.98 (44.38)	2.095	0.037*
	Telogen	12	46.87 (23.12)		
Female	Anagen	187	52.16 (17.64)	3.766	0.000*
	Telogen	13	33.39 (12.65)		

Table 2. Epilation Force for Males & Females

DISCUSSION

Trichotillometer is a non - invasive tool that estimates quantitatively and objectively the force required to epilate the hair. This device is not available commercially. To estimate the EF required to epilate hair from various regions of scalp, Instron universal Tensile Strength Tester 6021 (Instron limited, U K) equipment was utilized in this study. Instron universal tensile strength tester has been used to study the tensile strength and elasticity of the hair.¹ Greater force was required to epilate the anagen hair than the telogen hairs on all the areas of scalp and this difference was statistically significant. Greater force was required to epilate the anagen and telogen hairs in males than the females, which was statistically significant. Among the various regions of scalp frontal region required greater force to epilate the hairs (Both anagen and telogen) followed by vertex, parietal and occipital regions and this is not statistically significant.

Mechanical resistance of anagen hair while plucking is because of the following reasons, anagen follicle lies deeper, the dermal papilla connected to the fibrous sheath protrudes into the bulb and the inner root sheath is closely opposed to the shaft. Hence greater EF is required to pluck anagen hair than the telogen hair.

Few studies estimated the force required to pluck the hair in normal healthy volunteers using a hand held trichotillometer.^{2,3,4} Chase et al reported that the average observed range among well-nourished patients, when plucking 10 individual hairs, was 36.0 ± 12.4 g. Wyness et al reported that mean hair pluckability measurements for the 12 participants obtained by the three observers were 39.5 g, 41.2 g and 32.7 g respectively.³ Smelser et al. determined the usefulness of trichotillometry under field conditions by measuring hair epilation force of 69 subjects at a hospital in Nigeria, the mean force was 36.5 +/- 9.5 g. ⁴ The average EF reported in the above studies was 37.18 g which is low when compared to our finding of 63.10 gm for anagen and 39.86 gms for telogen hair. In our study the EF was calculated separately for the anagen and telogen hairs in various regions of scalp, which was not done in previous reports and this



Figure 1. Instron Universal Tensile Strength Tester

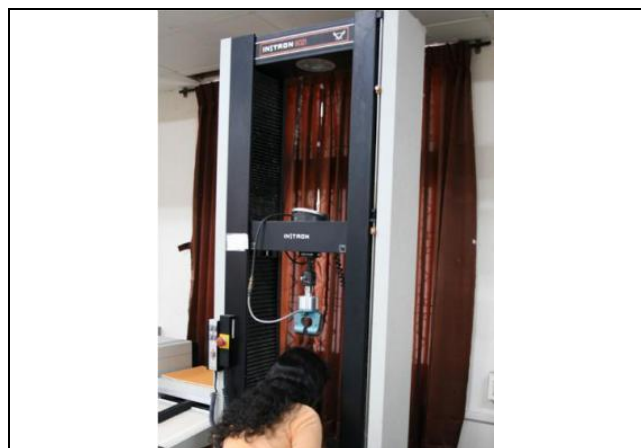


Figure 2. Volunteer Position for Determining EF

could explain the variations in the findings. This may be due to biological variation in hair pluckability as the force required to pluck hair is likely to vary throughout the different stages of growth, over the different regions of scalp and in different races.

The variations in EF among the individual and the observes has been reported in previous studies.³ In order to obtain a reproducible and representative mean hair pluckability measurement, an adequate amount of individual hairs need to be plucked and a standard instrument needs to be designed. In our study to eliminate the variations, the EF was measured separately for anagen and telogen hairs over the various regions of scalp and for both genders. We utilized the Instron universal Tensile Strength Tester 6021 to pluck the hair to avoid the intra-observer variation, since it is a mechanized device. If the reliability of the trichotillometer could be improved, for example, by adjusting the design, hair pluckability would be an extremely useful method of nutritional assessment and in assessment of the treatment response to various hair disorders.

CONCLUSION

Greater force was required to epilate the anagen hairs than telogen hairs on all the areas of scalp and greater force was required to epilate the anagen and telogen hairs in males than in females.

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