USER MANUAL

# TrichoScan Version 5.0


TRICHOLOG GmbH
79117 Freiburg, Germany

Datinf® GmbH
72074 Tübingen, Germany

# Contents

# Introduction

## Background

Hair loss or thinning hair is a common complaint among many people. Individuals seeking advice for hair loss are not necessarily bald. In established cases of androgenetic alopecia (AGA), characteristic patterns are easily recognizable. However, there is often the challenge that, particularly in women in the early stages of AGA, hair loss is reported, but alopecia is not visibly discernible, or the effect of treatment attempts is difficult to measure.

Numerous methods have been described to assess the rate of hair growth. The techniques can be classified as either invasive (e.g. biopsies), semi-invasive (trichogram, unit area trichogram) or non-invasive methods. However, while reviewing the capabilities of the different methods, the common theme emerges that most techniques are of little use because they are time consuming, often costly, or difficult to perform. Therefore, an operator- and subject-friendly, inexpensive, validated and reliable method of quantifying hair growth is a rational need. TrichoScan is such a method, combining standard epiluminescence microscopy (ELM) with automatic digital image analysis, for the measurement of human hair.

## Measuring method of TrichoScan

With the TrichoScan 5.0 version several different needs in hair science are met. Firstly, the most important parameters, such as hair thickness and hair count can be analysed within the same day. Secondly, the same target site can be used to calculate the number of anagen and telogen hairs by mathematical approximation. This handbook will guide you through the different possibilities.

There are three different modes with Trichoscan V 5.0:

A – Instant Mode: Determination of hair thickness and hair density (hair have to be clipped to about 0.5 mm)

B – Trichogram Mode: Determination of anagen / telogen hair count.

C – Hair color Mode: Determination of hair and skin color (brightness).

The following table shows the key differences between the modes Instant, Trichogram and Color.

| **Mode** | **Time of measurement** | **Anagen / telogen measurement** |
|---|---|---|
| **A -** Instant Mode | immediately | no |
| **B -** Trichogram Mode | after 2 days | yes |
| **C -** Hair color Mode | immediately | no |

## TrichoScan - Definitions

- TrichoScan V 5.0 is suitable for the analysis of human scalp hair.
- TrichoScan is a tool to monitor the most important hair parameters.
- TrichoScan V 5.0 is able to monitor total, vellus, and terminal hair density and, by mathematical approximation, the telogen and the anagen hair count.
- TrichoScan **is not** suitable for evaluating body hair or to monitor hair diseases.
- TrichoScan **is not** a diagnostic procedure.
- TrichoScan V 5.0 **is not** validated for clinical trials. We do not accept any responsibility when the tool is used for clinical trials.
- The TrichoScan analysis needs a clean and lightly pigmented skin to enable good contrast with dark colored hair. Dark melanocytic moles or dark scalp skin will diminish the contrast to the hairs and the analysis might not be possible.
- TrichoScan is a software program based on statistics and definitions of hair patterns. The software cannot diagnose telogen or anagen hair loss. However, based on the biological behavior of those hairs, they can be differentiated by mathematical approximation.

# TrichoScan-Procedures

## Preparing the subject

There is no special recommendation. The subject may wash their hair before the analysis.

## Choosing the optimal measurement site

The use of TrichoScan requires a representative area of the scalp to be shaved. To achieve a cosmetically acceptable result, the following should be observed.

Areas unsuitable for shaving are:

- The parting
- The occipital whorl

To achieve a pleasing appearance by allowing nearby hairs to be combed over the shaved area, shave at a distance of two finger widths from the parting (see Fig. 1). This should be done along the receding hairline of the fronto-temporal regions or at the vertex.

The mask is applied and hair in the selected area is pulled through the mask (figs. 2 and 3). The hair exposed through the mask is shaved (fig. 4) to leave a small neat spot (fig. 5).

Fig. 1: The shaving mask is positioned about two fingers width away from the parting or any other suitable measurement site.

Fig. 2: The hair in the area to be shaved is exposed with a curved hook or with pointed scissors.

Fig. 3: Hair after exposure is clipped.

Fig. 4: Exposed hair, should **not** be completely clipped down to the bare scalp. Best results are achieved by a speedy and gentle clipping process. Some stubble **must** remain.

Fig. 5: After clipping, the clipped hairs can be removed with sticky tape.

The hair must not be clipped down to the scalp surface. Short hair shafts should remain visible. This is achieved by a diagonal shaving technique (fig. 4). The clipped hair length has to be set according to the mode, Instant is used (mode Instant or mode Trichogram, see above).

## Recording the images

For recording, the lens of the digital camera's optical attachment is pressed on the wet measurement area without air bubbles (figs. 6 and 7). Please use an alcohol spray or tap water to wet the area sufficiently. This obligatory procedure makes sure that no air bubbles are trapped

between the scalp and the lens. Oil is not a suitable alternative to the alcohol spray or water.

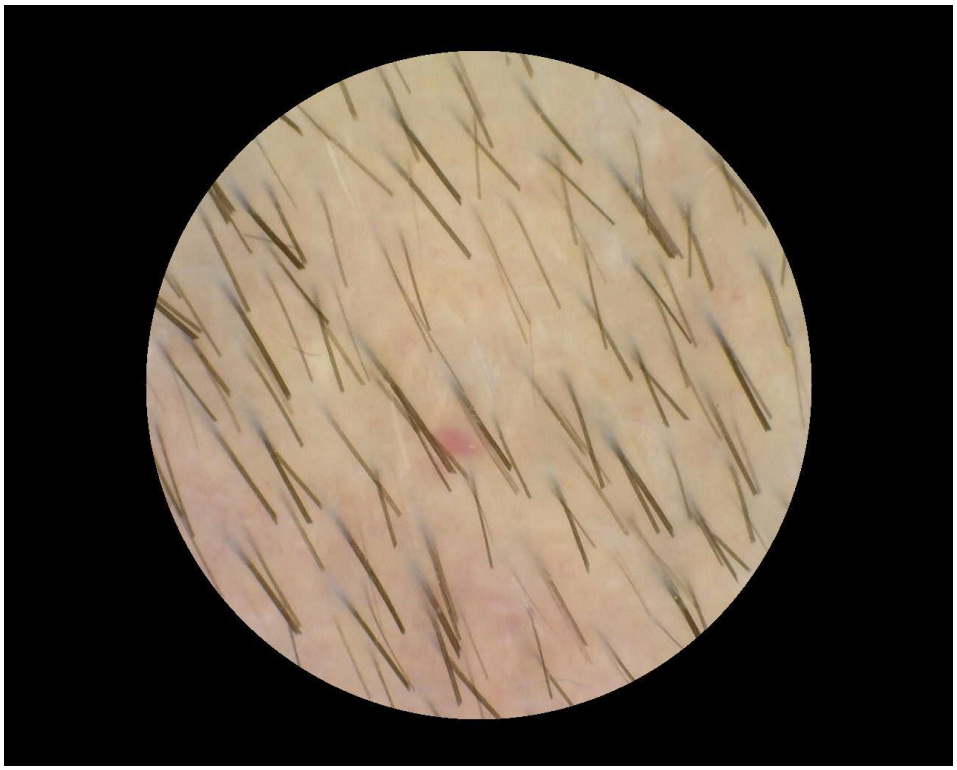


Fig. 6: A perfect TrichoScan image.

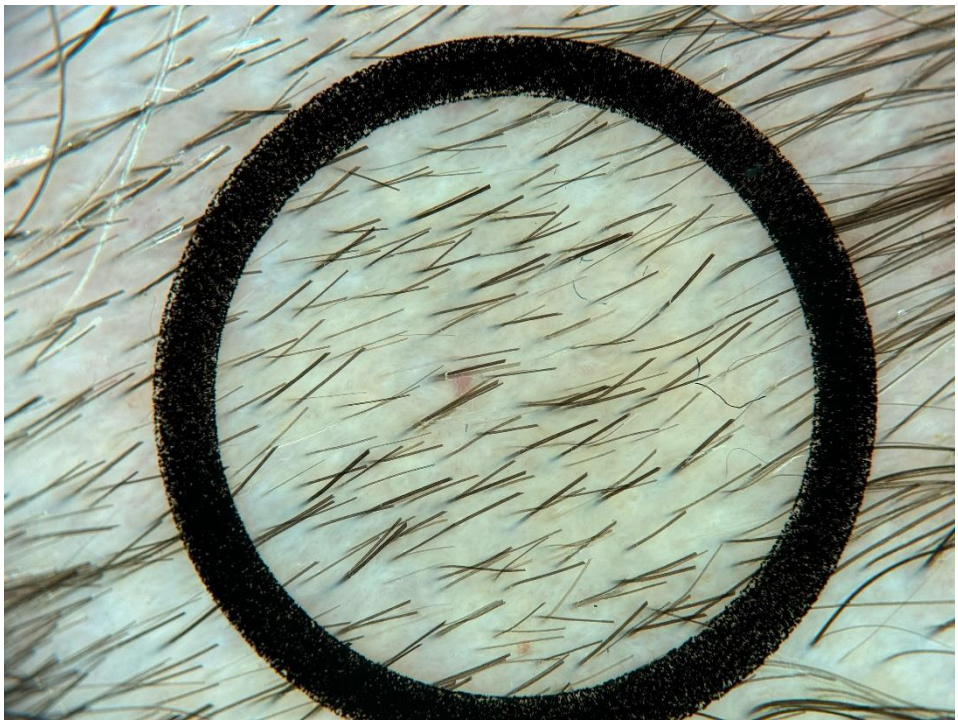


Fig. 7: A perfect TrichoScan image.

## Suitable Images for TrichoScan

As an automated image analysis tool, the TrichoScan results strongly depend on the image quality.

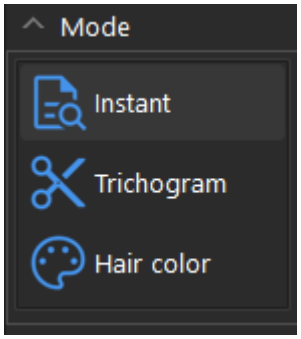
Suitable images include the following properties:

- Sharp images without remnants of shaved hair.
- Wet hairs without air bubbles present.
- In focus with no long hairs passing into the measurement site from outside.
- Hairs are evenly clipped.
- Hairs have a minimum length of approximately 0.5 mm to allow detection by the TrichoScan software. Stubbles that are too short will escape the analysis as the software algorithms define hair as being longer than 0.5 mm.
- The scalp is lightly pigmented. Heavily pigmented scalp results in insufficient contrast for hair detection.

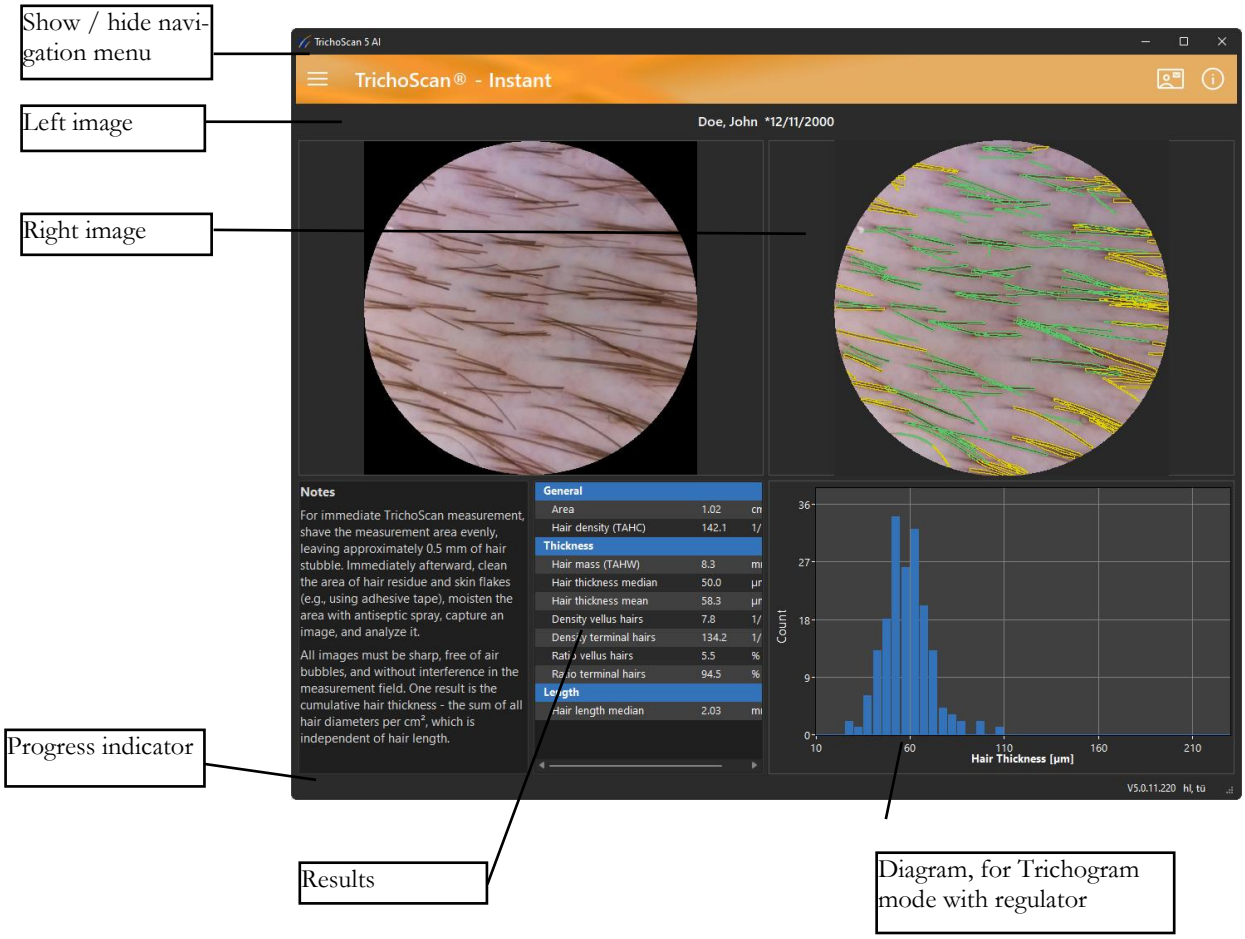
Then the image is ready for the TrichoScan analysis.

# TrichoScan analysis

The recorded photographs are loaded into the TrichoScan software, which automatically performs the initial analysis. There are three modes: Instant mode, Trichogram mode, and Color mode.




## A – Mode TrichoScan




**Show / hide navigation menu:** In the menu e. g. the mode can be changed or a report can be printed. For the Trichogram mode, a score can be shown.

**Left image:** Here the area to be analyzed has a blue border once the image has been loaded.

**Right image:** According to the stage of the analysis, various distinguishing features are marked which give an indication of the progress of the image analysis (red: telogen hair, yellow: hairs that touch the border, green: anagen hair).

**Result:** The results area shows values for the analyzed area, the estimated image quality and hair parameters (see below).

**Diagram:** The diagram shows the frequency distribution of hair length. The red line marks the maximum length of telogen hairs defined in the software analysis.

# B – Mode Trichogram

In the mode Trichogram, the anagen / telogen ratio can be measured, additionally. Therefore, after preparing the scalp and measuring two days after clipping, the cut-off for anagen and telogen hairs can be set by a regulator which is located above the diagram: The slider enables the maximal hair length for defining telogen hairs to be manually adjusted by the user when the software is in the “Trichogram” mode. Color-coding of the hairs indicates the group they belong to.

- Red: Telogen hair.
- Yellow: Hair is touching the edge of the picture, grouping follows via a special statistical procedure (Product-Limit-Estimation).
- Green: Anagen hair.

## *Telogen hair*

In the software sense a telogen hair is a non-growing hair. For this analysis the hair should be clipped as above (figs. 1-5) during the first visit. The subject must return three days after hair clipping and then an image is taken for TrichoScan analysis (figs. 6-7). The software will measure the length of all hairs and by statistical analysis will discriminate between growing versus non-growing hairs. Please note that catagen and exogen hairs also do not grow significantly within this time period and will also be judged as non-growing hairs. Therefore, the calculated telogen hair values will be a bit higher than may normally be expected. For this analysis to be accurate a very uniform hair clipping is mandatory to ensure the remaining hair stubble is of equal length. For less expert hair clippers, we recommend the use the anagen hair count tool instead. An anagen hair count requires less hair clipping consistency and so it is much easier to obtain accurate results with this approach.

## C – Mode Hair color

In this mode, various distribution parameters of hair color, specifically the brightness levels, are provided. For comparison, the same values are also determined for the skin.

## Results – Hair parameters

Some parameters are only output for specific modes.

**Total hair count**: The number of detected hairs.

**Hair density (1/cm²)**: With the TrichoScan V 5.0 edition it is possible to calculate the number of hairs detected (hair count) and the hair density (hairs / $cm^2$). Please note, that due to the image resolution of digital cameras the TrichoScan software cannot detect very fine hairs (approx. less than 10µm diameter). In addition, TrichoScan cannot identify hairs which are too short for analysis (approx. less than 0.3 mm in length). As digital camera image resolution improves, these limitations may change in the future.

**Hair mass (mm/cm²)**: The cumulated thickness (diameters) of hairs normalized for an area of 1 $cm^2$.

**Hair thickness median (µm)**: The median of the distribution of the hair thicknesses (diameters).

**Hair thickness mean (µm)**: The mean of the distribution of the hair thicknesses (diameters).

**Density vellus hairs (1/cm²)**: By definition a vellus hair is thinner than 40µm. Trichoscan uses this value to identify vellus hairs in images. The number of vellus hairs relative to terminal hairs is also calculated and provided in the analysis results.

**Density terminal hairs (1/cm²)**: By definition a terminal hair is thicker than 40µm. Trichoscan uses this value to identify terminal hairs in images. The number of terminal hairs relative to vellus hairs is also calculated and provided in the analysis results.

**Ratio vellus hairs (%)**: Ratio of vellus hairs to total hairs in percent.

**Ratio terminal hairs (%)**: Ratio of terminal hairs to total hairs in percent.

**Anagen hairs (%)** [1]: Ratio of anagen hairs to total hairs in percent. In the definition of the TrichoScan procedure, an anagen hair is a hair

[1] only available in mode Trichogram

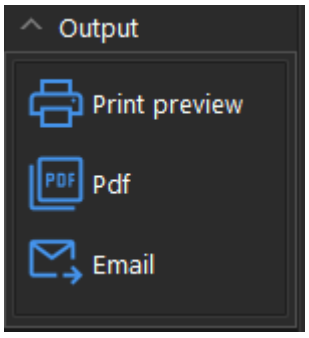
which is detectable three days after complete hair shaving. Within this time only anagen hairs should grow significantly.

**Telogen hairs (%)** [1]: Ratio of telogen hairs to total hairs in percent. By definition a telogen hair will not grow whereas anagen hairs do. When images are taken three days after hair clipping, growing hairs can be differentiated from non-growing hairs based on different hair length. TrichoScan identifies non-growing hairs as telogen hairs and growing hairs as anagen hairs.

**Hair length median (mm)**: Median of the distribution of the estimated hair length.

**Hair/skin color:** Mean, median, standard deviation (SD), and interquartile range (IQR) respectively.

## Output Options: Print, PDF, and Email

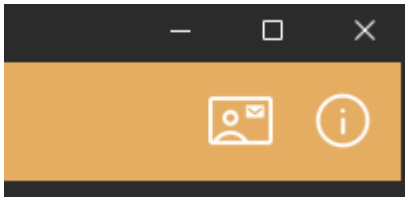



There are different ways to output the results. They can be printed, saved as a PDF, or sent via email.

When outputting the results, the current results of the chosen mode are displayed. Additionally, information about the name and location of the software license owner appears at the bottom edge of the image.

## Support

The program was tested using many images with numerous parameters. However, there is the possibility that not all of the hairs are correctly recognized in an image.



In case of any technical problems, such as recognizable hairs not being identified by the TrichoScan software, please send the image along with additional information via email to support@datinf.de. This can be done easily using the send button (left button in the picture above). This information will also be used to further improve and develop the TrichoScan software system.

Up to date and additional information about TrichoScan can be found on the Internet at www.trichoscan.com.

In case of problems concerning the recording images and technical issues of the recording system, please contact the manufacturer.

Content-related questions, such as enquiries about measurement results, can be addressed to Prof. Rolf Hoffmann, MD in Freiburg, Germany (Email: info@tricholog.de).

If you have any technical problems or TrichoScan software program faults, please contact the TrichoScan software engineers (Email: support@datinf.de).

# Appendix

## References

[1] Rushton H, James KC, Mortimer CH
The unit area trichogram in the assessment of androgen-dependent alopecia.
Br J Dermatol Oct 1983; 109(4):429-37

[2] de Lacharriere O, Deloche C, Misciali C, Piraccini BM, Vincenzi C, Bastien P, Tardy I, Bernard BA, Tosti A
Hair diameter diversity: a clinical sign reflecting the follicle miniaturization.
Arch Dermatol. May 2001; 137(5):641-646

[3] Hoffmann R
TrichoScan: Ein neues Werkzeug für die digitale Haarzählung.
Hautarzt. Dec 2002; 53:798-804

[4] Hoffmann R
TrichoScan: combining epiluminescence microscopy with digital image analysis for the measurement of hair growth *in vivo.*
Eur J Dermatol. Jul-Aug 2001; 4(11):362-368

[5] Hoffmann R
TrichoScan: a novel tool for the analysis of hair growth in vivo.
J Investig Dermatol Symp Proc. 2003 Jun; 8(1):109-15

[6] Chamberlain AJ, Dawber RP
Methods of evaluating hair growth.
Australas J Dermatol. Feb 2003; 44(1):10-8. Review

[7] Hoffmann R
Trichoscan: what is new?
Dermatology. 2005;211(1):54-62. Review.

[8] Hoffmann R, Van Neste D.
Recent findings with computerized methods for scalp hair growth measurements.
J Investig Dermatol Symp Proc. 2005 Dec;10(3):285-8.

# TrichoScan target sites

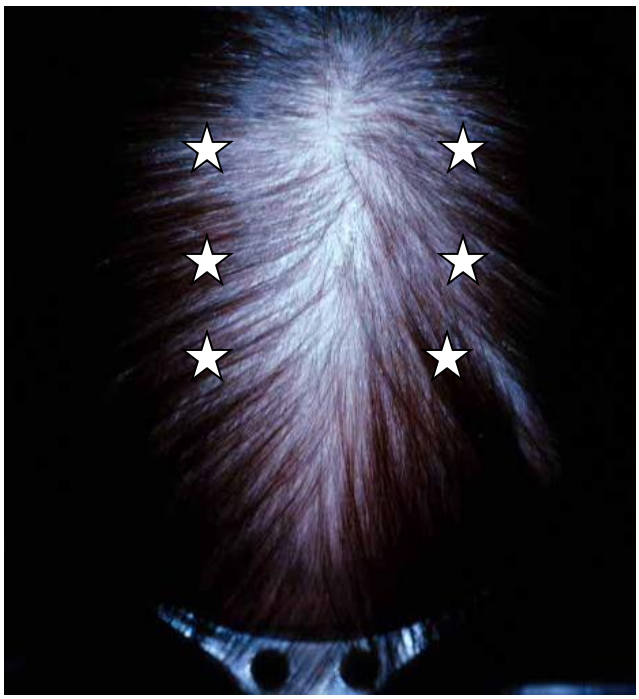


Fig. 8: Recommended TrichoScan target site (stars).

Fig. 9: Recommended TrichoScan target site (stars).

Fig. 10 Recommended TrichoScan target site (stars).

Fig 11: Recommended TrichoScan target site (stars).

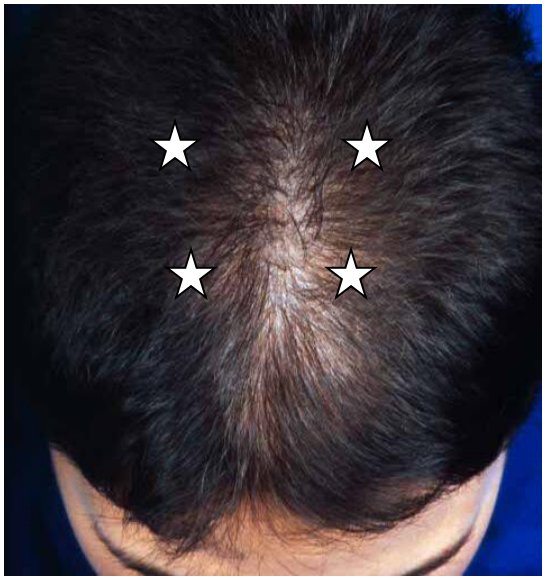


Fig 12: Recommended TrichoScan target site (stars).

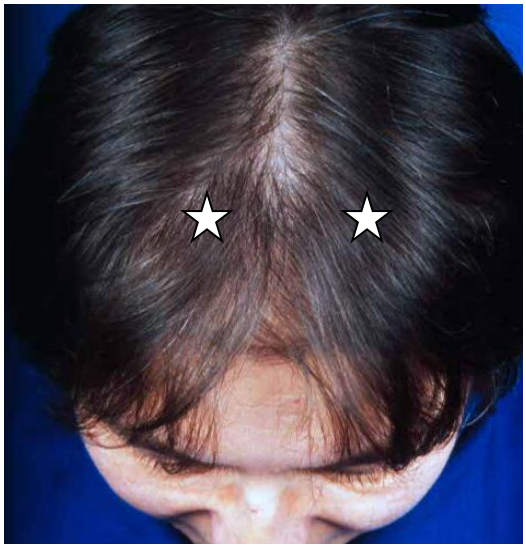
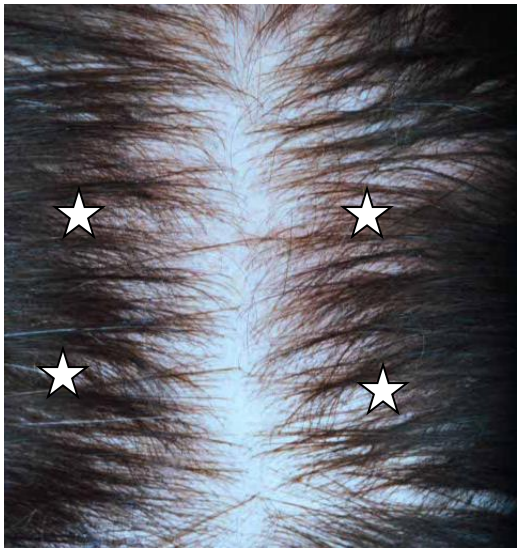


Fig. 13: Recommended TrichoScan target site (stars).

Fig. 14: Recommended TrichoScan target site (stars).



## Another example of preparations for TrichoScan.

Fig.15: Example of androgenetic alopecia in women.

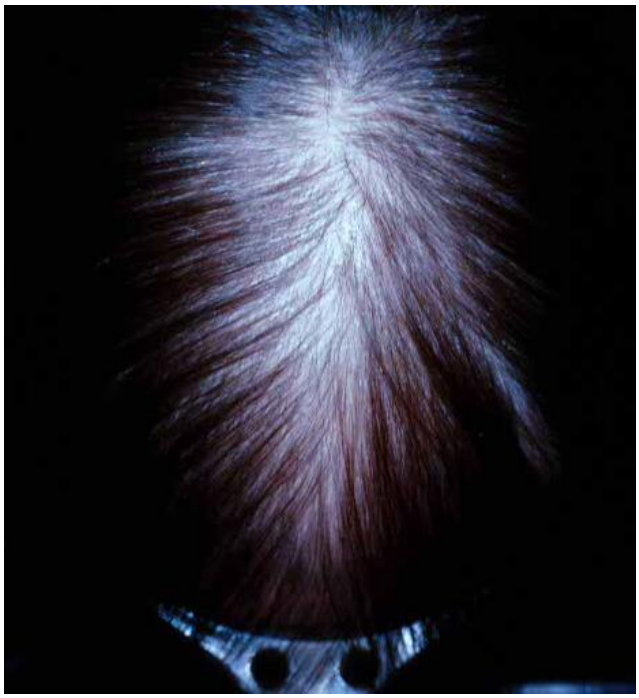


Fig. 16: Example of androgenetic alopecia in women. For shaving, an area approximately 2 cm beside the middle parting should be chosen.

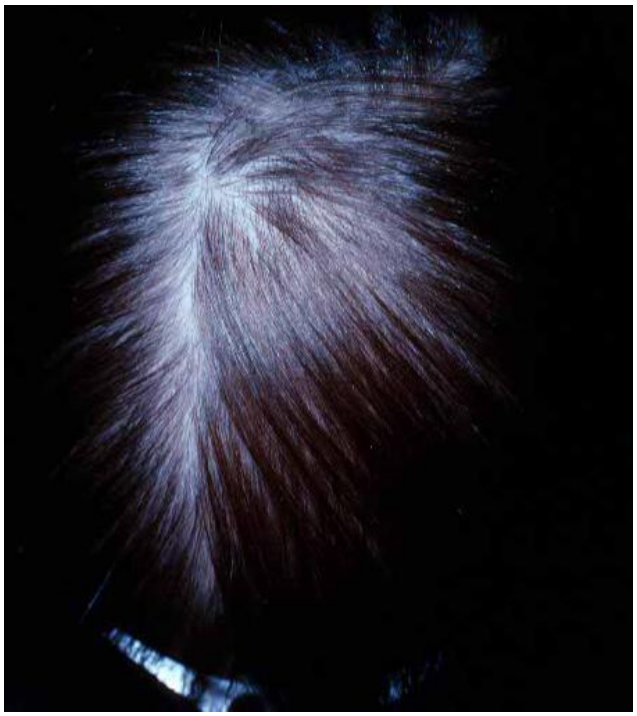


Fig. 17: Post-shaving condition

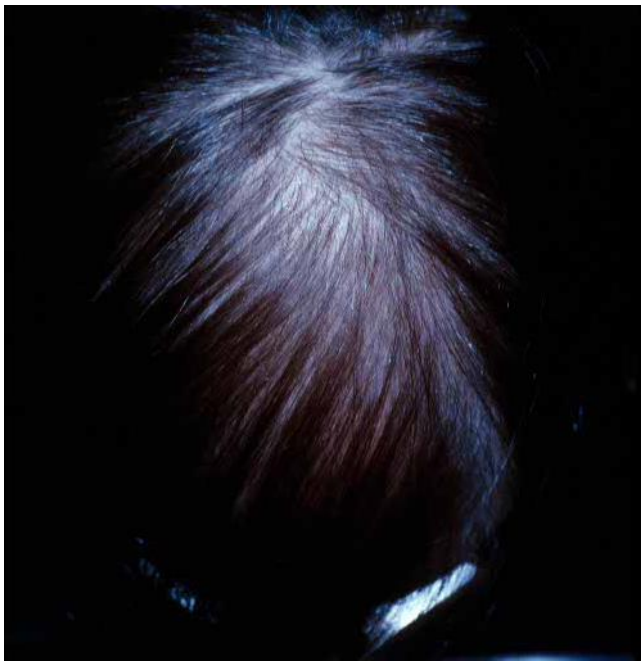


Fig. 18: The shaved area is covered by other hair.

# Typical alopecia images

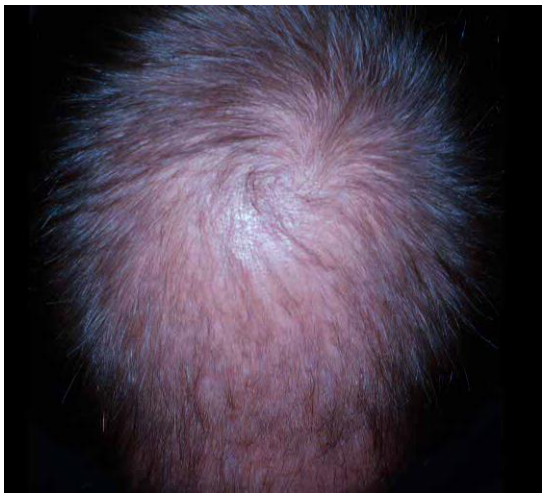


Fig. 19: Example of advanced androgenetic alopecia in men ("female pattern"). For shaving, an area in the transition zone between the alopecic region and still-haired areas should be selected.

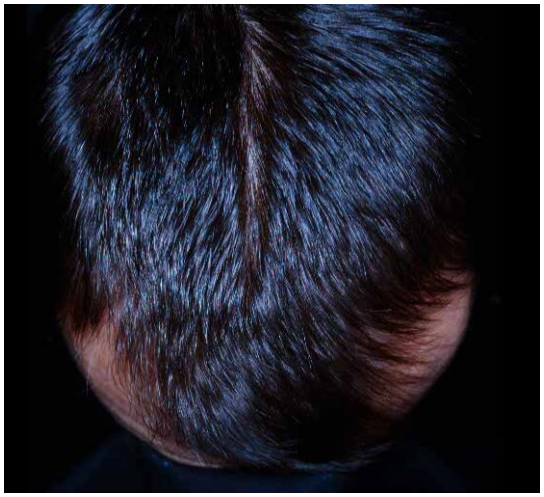


Fig. 20: Example of androgenetic alopecia in men. Even with a receding hairline ("male pattern"), an area in the transition zone between the alopecic region and still-haired areas should be selected for shaving.

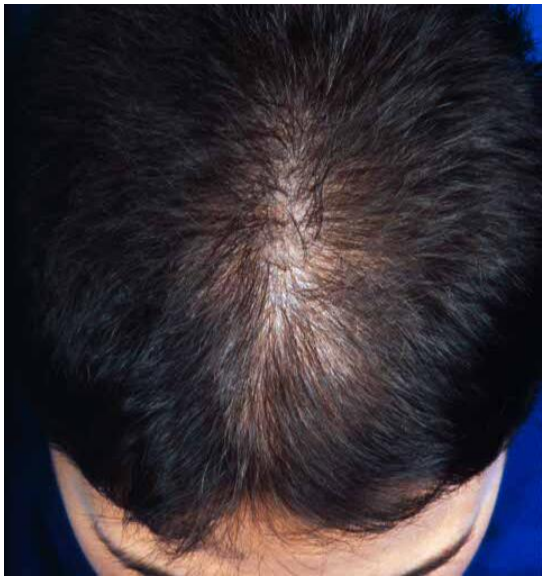


Fig. 21: Example of mild androgenetic alopecia in men ("female pattern"). For shaving, an area in the transition zone between the alopecic region and still-haired areas should be selected.

Fig. 22: Example of mild androgenetic alopecia in women (Ludwig grade I).

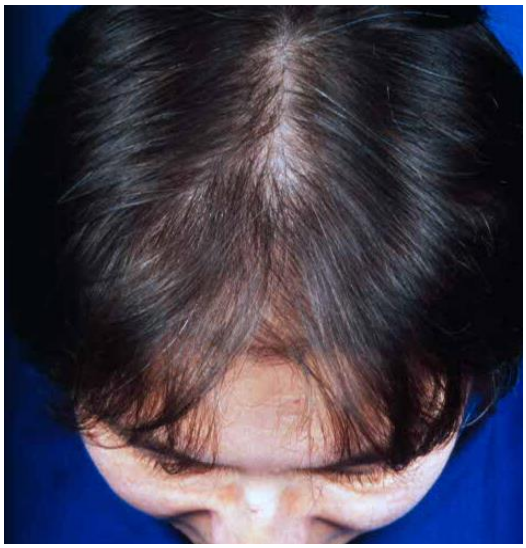


Fig. 23: Example of mild androgenetic alopecia in women (Ludwig grade I). For shaving, an area approximately 2 cm beside the middle parting should be selected.

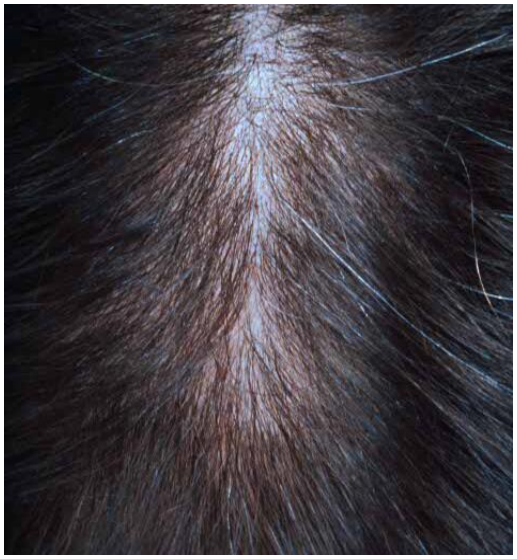
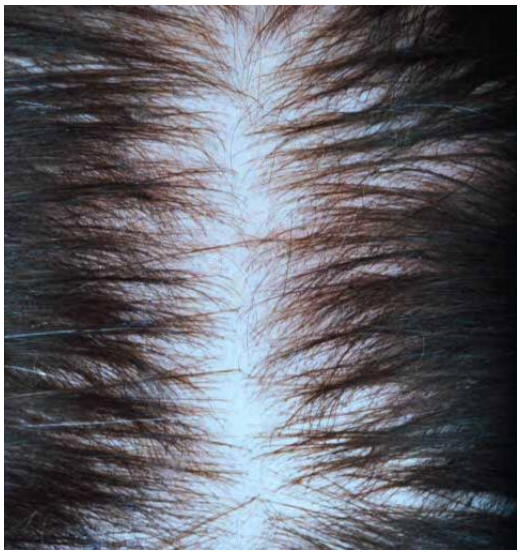


Fig. 24: Example of advanced androgenetic alopecia in women (Ludwig grade II). For shaving, an area approximately 2 cm beside the middle parting should be selected.



# Images not suitable for TrichoScan analysis

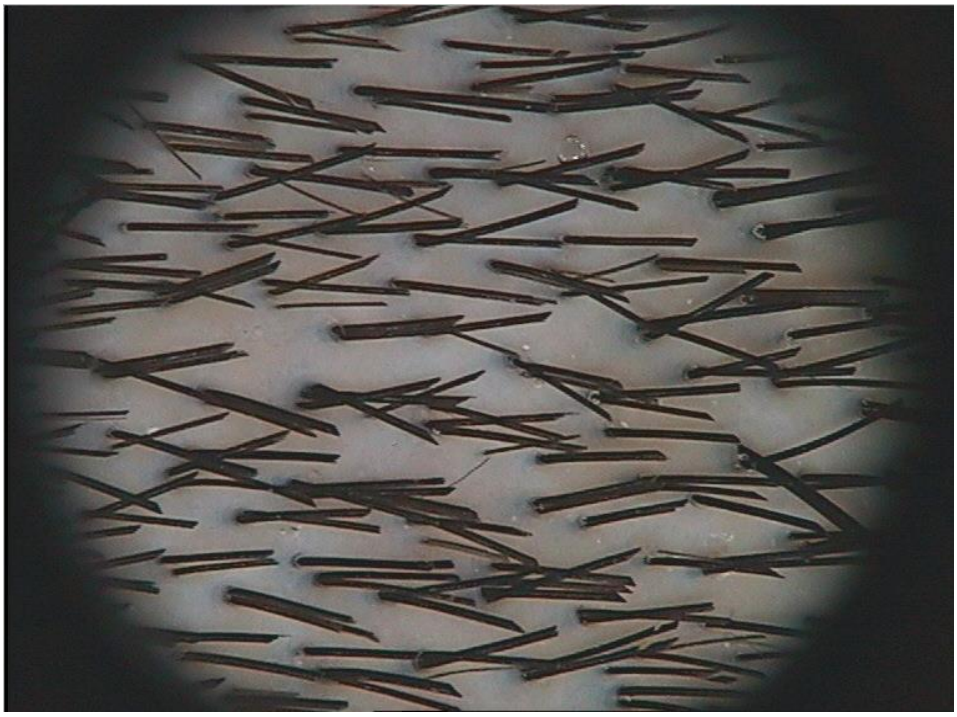


Fig. 25: The software is not capable of seeing more than humans. If the hairs are too densely packed, errors may occur.

***Remedy***:
Trim hair

Fig. 26: Hairs from the outside cross the TrichoScan target area making it unsuitable for analysis.

***Remedy***:
Remove or shave long hairs from the image area.

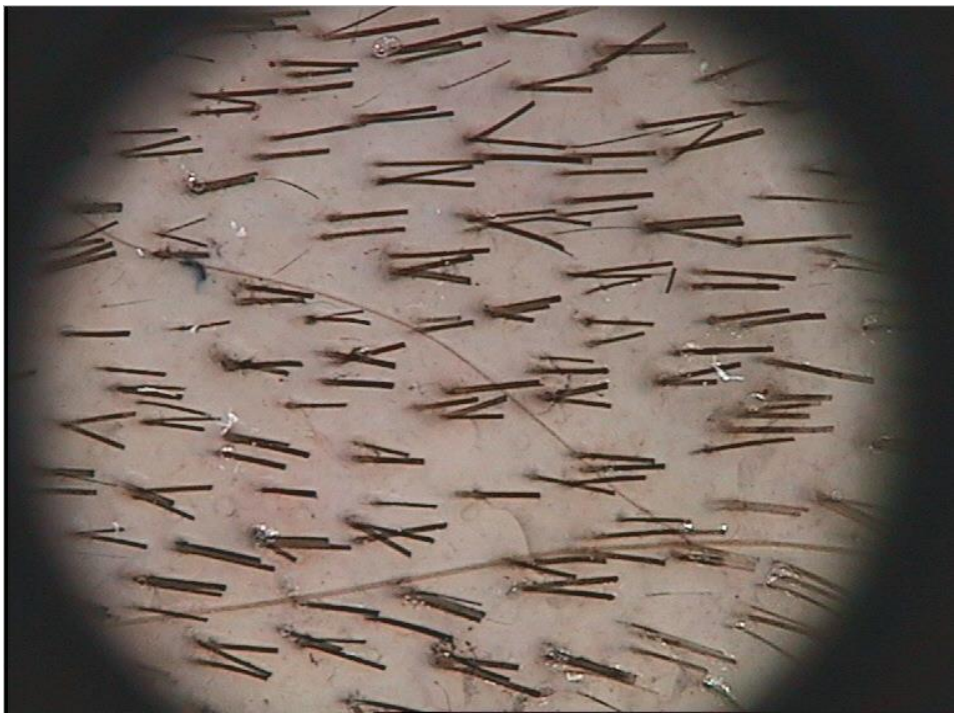


Fig. 27: Too many air bubbles make this image unsuitable for analysis.

***Remedy***:
Retake with slightly more pressure.