Novel potential histologic clues to mechanical alopecia: A comparative study of traction alopecia, trichotillomania, and approximately age/gender-matched controls

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Disclosures

- I do not have any relevant financial relationships to disclose.
- The opinions and assertions expressed herein are those of the authors and do not necessarily reflect the official policy or position of the US Army, Department of War, or the US Federal Government.

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Mechanical alopecia: alopecia due to physical trauma (traction, friction, pulling)

TRACTION ALOPECIA (TA)

TRICHOTILLOMANIA (TTM)

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"Alopecia Groenlandica"

- R. Trebtisch (Austrian Dermatologist, 1907)

From: National Geographic, October 1949, page 486. Public access.
Reference: Billero & Miteva (2018)

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Review Article

Traction alopecia: A neglected entity in 2017?

Christiana Oyinlola Akingbola, Jui Vyas

Department of Dermatology, School of Medicine, Cardiff University, Cardiff, CF, UK

Oyinlola & Vyas 2017. Indian J Dermatol Venereol Leprol

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"Pinch points"

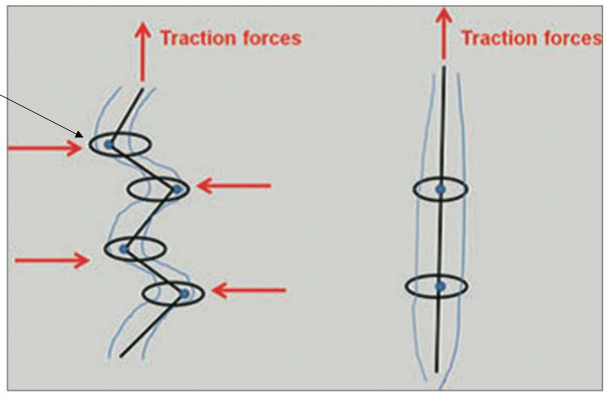

Figure 7: Diagram showing predisposition of curly African hair (left) to traction damage along its length versus straight Caucasian hair (right). (Points of weakness in red). Image from Miteva and Tosti, 2012[29] Copyright 2012 by John Wiley and Sons

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Mechanical Alopecia: "Under"-studied?

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Traction Alopecia	Trichotillomania
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J Am Acad Dermatol
October 2023

DERMATOPATHOLOGY

The histopathologic diagnosis of traction alopecia: An evidence-based model

Michelle A. Pitch, MD,[a] and Leonard C. Sperling, MD[b,c,†]

Pitch & Sperling 2023. J Am Acad Dermatol

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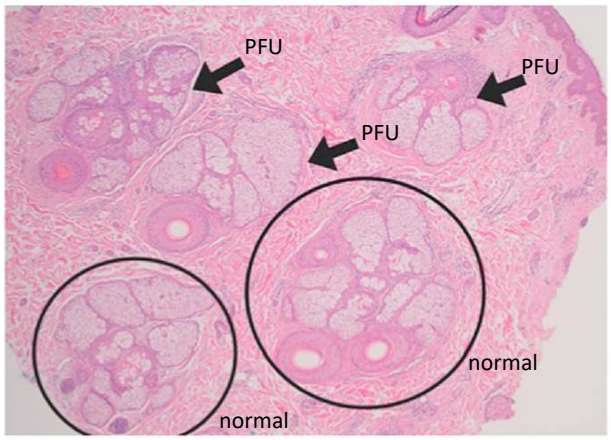

Fig 1. Paucifollicular units (PFUs) with intact sebaceous glands and <2 associated follicles (*arrows*). Normal follicular units are circled for comparison.

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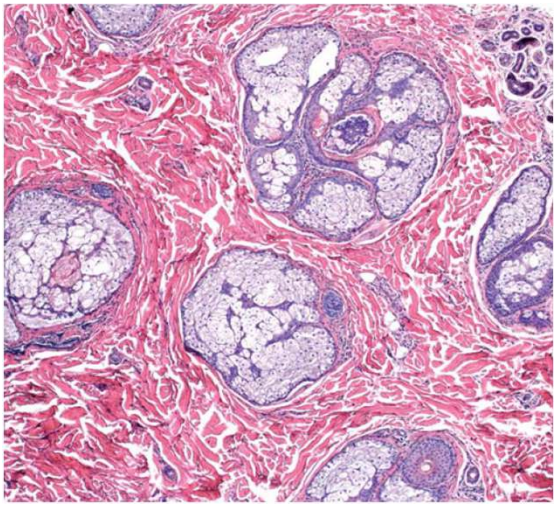

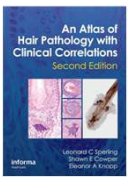

Sperling, Cowper, & Knopp 2012. "*An Atlas of Hair Pathology with Clinical Correlations*"

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Mechanical Alopecia: "Under"-studied?

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Journal of Cutaneous Pathology 1977: 4: 51–67

Traumatic Alopecia in Trichotillomania: a Pathogenic Interpretation of Histologic Lesions in the Pilosebaceous Unit*

J. M. LACHAPELLE and G. E. PIERARD

Unit and Laboratory for Occupational Dermatoses, University of Louvain, and Department of Dermatology, University of Liège, Belgium

Lachapelle & Pierard 1977. J Cutan Pathol

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Table 1
Relative frequency of the different histopathologic signs in Traumatic Alopecia

Histopathologic signs	Patients (P) 1	2	3	4	5	6	7	8	9	10	Frequency %
Specific markers (SM)											
Empty hair canals	+	+	+	+	+	+	+	+	+	+	100
Plucked out hair bulbs			+		+						20
Clefts in hair matrix	+	+		+	+		+				50
Catagen involution of empty outer root sheaths	+	+	+		+	+	+	+			70
Miescher's trichomalacia in the deep dermis	+		+		+				+		40
Torn off sebaceous glands	+				+				+		30
SM/P	5	3	4	2	6	2	3	2	3	1	
Unspecific markers (UM)											
Normal anagen VI hairs	+	+	+	+	+	+	+	+	+	+	100
Catagen hairs	+	+			+	+	+	+		+	70
Infundibular plugging	+	+	+	+	+	+	+	+	+	+	100
Melanin in keratin plugs	+	+		+		+	+	+		+	70
Melanin in the papilla	+	+	+	+	+	+	+	+			80
UM/P	5	5	3	4	4	5	5	5	2	4	

Lachapelle & Pierard 1977. J Cutan Pathol

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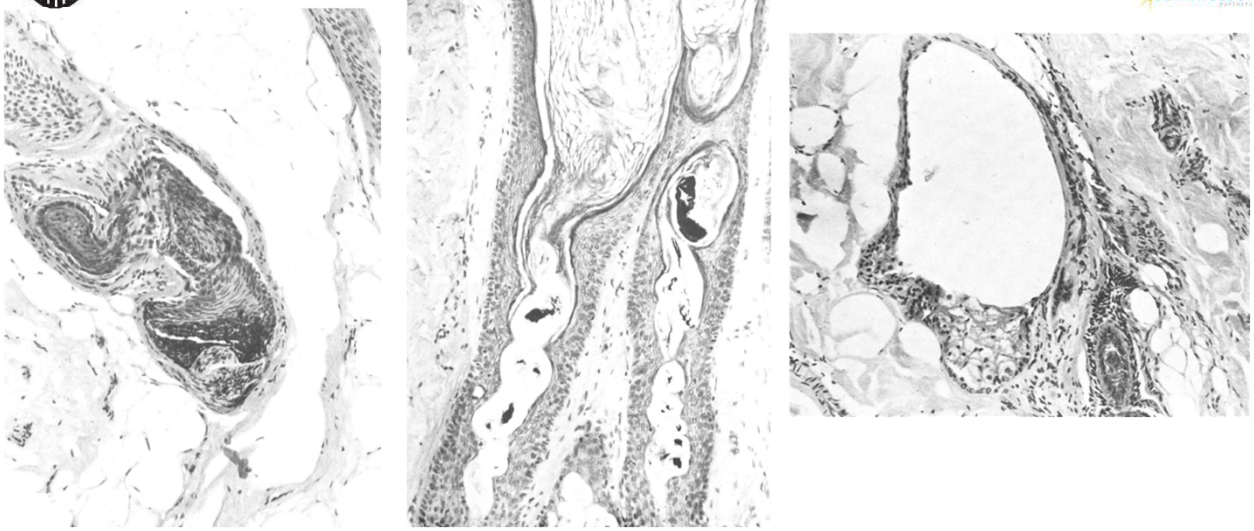

Lachapelle & Pierard 1977. J Cutan Pathol

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J. M. LACHAPELLE and G. E. PIERARD

Unit and Laboratory for Occupational Dermatoses, University of Louvain, and Department of Dermatology, University of Liège, Belgium

"This histologic pattern of trichotillomania is incomplete, depending upon factors such as intensity of pulling and/or time of biopsy after plucking."

Lachapelle & Pierard 1977. J Cutan Pathol

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J Cutan Pathol 2006: 33 (Suppl. 2): 63–64
Blackwell Munksgaard. Printed in Singapore

Journal of Cutaneous Pathology

Splitting hairs: the 'hamburger sign' in trichotillomania

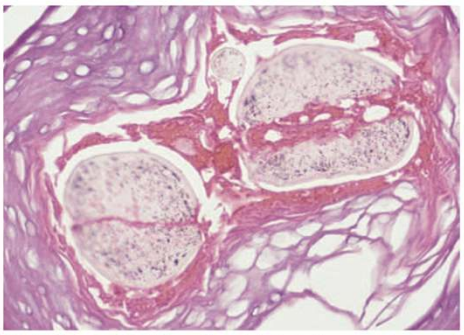

Fig. 2. Two terminal hairs with split hair shafts, containing proteinaceous material and erythrocytes within the split (hematoxylin and eosin, ×400).

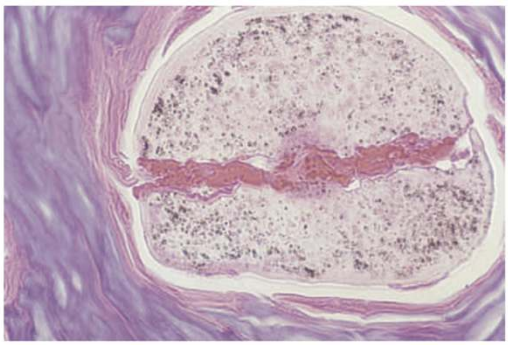

Fig. 3. High-power image of another hair shaft exhibiting a central split (hematoxylin and eosin, ×1000).

Royer & Sperling 2006. J Cutan Pathol

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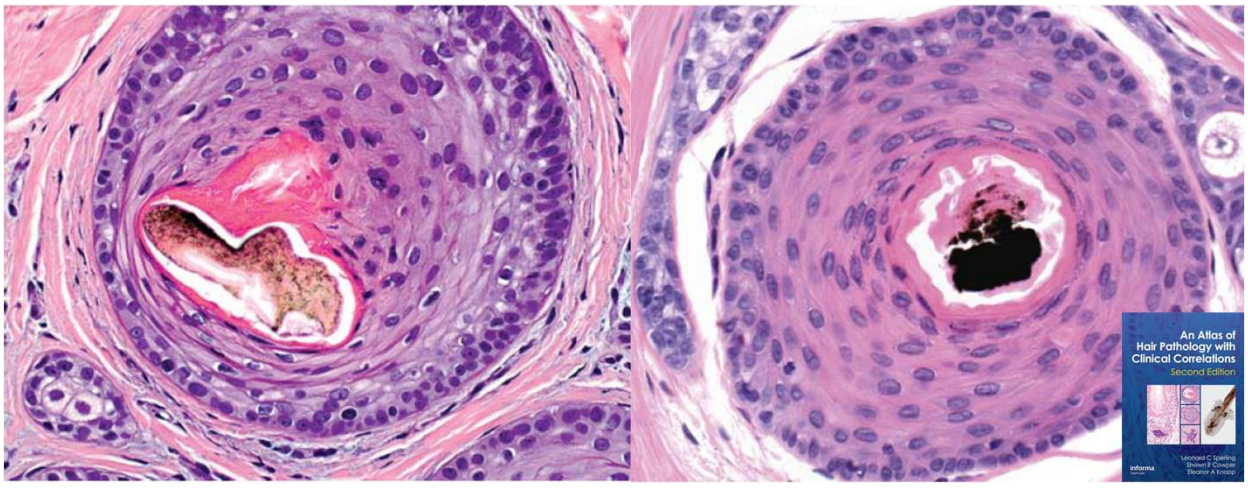

Sperling, Cowper, & Knopp 2012. "*An Atlas of Hair Pathology with Clinical Correlations*"

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Clinical review

Lesson of the week

Child abuse and trichotillomania

A Saraswat

Localised hair loss in a child may be the sole sign of child abuse

Department of Dermatology, Era's Lucknow Medical College and Hospital, Lucknow 226 016, India
A Saraswat
assistant professor

"The background in which trichotillomania develops is quite similar to the risk factors for child abuse. In children, trichotillomania often starts at times of psychosocial stress within the family unit such as a disturbed mother-child relationship, hospitalisations, periods of separation, or developmental problems. Recently, a strong relationship of family chaos during childhood and trichotillomania has also been reported, in which 86% of women with trichotillomania reported a history of violence—for example, sexual assault or rape—concurrent with the onset of trichotillomania. Similar factors, such as violence between parents or siblings, disturbed parent-child interaction, recent death, or illness in the family have been well described as criteria for suspecting child abuse."

Saraswat 2005. BMJ

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Mechanical alopecia: Current histologic clues

Traction Alopecia	Trichotillomania
1. Marked decrease in total number of follicles and terminal follicles with retention of vellus hairs 2. Sebaceous lobules without terminal hairs 3. Pauci-follicular units 4. No significant inflammation 5. Fibrous streamers 6. Variably increased catagen/telogen hairs	1. Trichomalacia 2. Pigmented hair casts 3. Peri- and Intrafollicular hemorrhage 4. "Hamburger sign" 5. Sebaceous lobule translocation to follicular canal 6. Variably increased catagen/telogen hairs 7. Collapse of the inner root sheath

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"Classic" Features → Later/Advanced Disease

- Today's biopsies: Classic histologic features not always present
  - *Increasing patient awareness of 'alopecia'* → **Patients presenting earlier**
  - *Clinicians eager to exclude inflammatory/scarring disease* → **Prompt biopsy**
- Are there other histopathologic clues to a mechanical (traction vs. trichotillomania) alopecia that can aid the dermatopathologist and increase diagnostic sensitivity for these conditions?

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Through careful clinicopathologic correlation, **several putative structural anomalies of the pilosebaceous unit were observed.** These are hypothesized to reflect mechanistic tension on the pilosebaceous unit and may potentially aid in the diagnosis of a mechanical alopecia

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Methods

- IRB-approved (Advarra Pro00082838)
- Systematic, qualitative, and quantitative study of pilosebaceous units from clinically and histopathologically-confirmed, horizontally-processed cases of:
  - Traction alopecia (n = 16)
  - Trichotillomania (n = 9)
  - Controls (n = 15): Approximately age, gender, and ethnicity-matched cases without evidence of an inflammatory, scarring, or mechanical alopecia
- Three board-certified dermatopathologists blinded to demographic information separately reviewed all cases for presence/absence of specific histologic alterations and re-convened for final consensus

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Results

Cases were nearly matched with controls for age, gender, and ethnicity

Table 1. Summary of demographic data

Variable	Cases: TA + TTM	Control	p-value	SMD
Total # of cases	25	15	---	---
Age (μ±σ, median, range)	38.2±11.7, 37, 15-74	40.2±15.5, 41, 17-77	0.6546	- 0.148
Female (#, %)	23 of 25, 92.0%	14 of 15 (93.3%)	1	- 0.051
Male (#, %)	2 of 25, 8.0%	1 of 15 (6.7%)		
African-American (#, %)	19 of 25 (76.0%)	10 of 15 (66.7%)	0.7162	0.206
Non-African American	6 of 25 (24.0%)	5 of 15 (33.3%)		

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Results

Feature	Control (n, %)	TA (n, %)	TTM (n, %)	chi2_p	Control_vs_TA_p	Control_vs_TTM_p	TA_vs_TTM_p
Collapsed inner root sheath	0/15 (0.0%)	10/16 (62.5%)	7/9 (77.8%)	0.0001	0.0002	0.0001	0.6608
Collapsed inner root sheath (Lower level)	2/15 (13.3%)	0/16 (0.0%)	6/9 (66.7%)	0.0002	0.2258	0.0215	0.0005
Collapsed inner root sheath (Upper level)	0/15 (0.0%)	10/16 (62.5%)	6/9 (66.7%)	0.0003	0.0002	0.0006	1
Combined folliculostromal tearing	0/15 (0.0%)	4/16 (25.0%)	3/9 (33.3%)	0.0683	0.1012	0.0415	0.6729
Follicular keratinocyte cleavage	5/15 (33.3%)	10/16 (62.5%)	7/9 (77.8%)	0.0783	0.1556	0.0894	0.6608
Hamburger sign	0/15 (0.0%)	0/16 (0.0%)	0/9 (0.0%)		1	1	1
Lateral impingement of follicular canal	0/15 (0.0%)	14/16 (87.5%)	4/9 (44.4%)	0.0000	0.0000	0.0119	0.0581
Multifocal sebolytic cleavage	8/15 (53.3%)	6/16 (37.5%)	6/9 (66.7%)	0.3558	0.4795	0.6785	0.2262
Pauci-follicular units (PFU)	0/15 (0.0%)	10/16 (62.5%)	1/9 (11.1%)	0.0002	0.0002	0.3750	0.0330
Sebocytes in follicular canal	0/15 (0.0%)	0/16 (0.0%)	2/9 (22.2%)	0.0266	1	0.1304	0.1200
Single cell sebolysis	7/15 (46.7%)	3/16 (18.8%)	2/9 (22.2%)	0.2011	0.1351	0.3891	1
Surface lichenification	0/15 (0.0%)	1/16 (6.2%)	7/9 (77.8%)	0.0000	1	0.0001	0.0005
Trichomalacia/Pigment cast	0/15 (0.0%)	0/16 (0.0%)	7/9 (77.8%)	0.0000	1	0.0001	0.0001
Vectorially warped sebaceous lobules	0/15 (0.0%)	11/16 (68.8%)	2/9 (22.2%)	0.0002	0.0001	0.1304	0.0414

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Vectorially Warped Sebaceous Lobules

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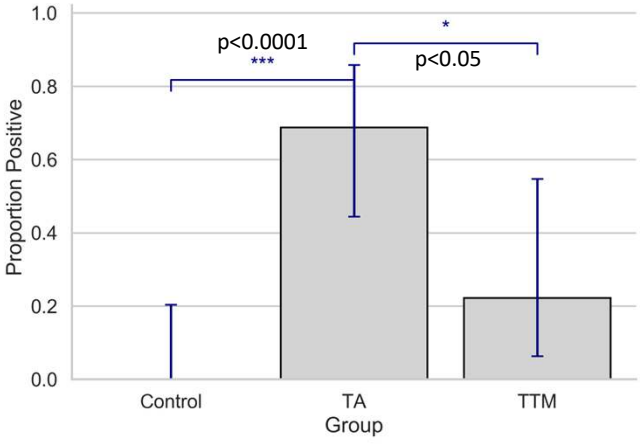
Vectorially Warped Sebaceous Lobules



TA = traction alopecia
TTM = trichotillomania

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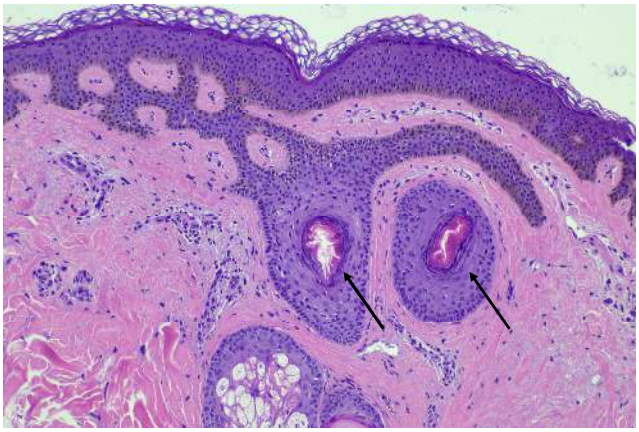
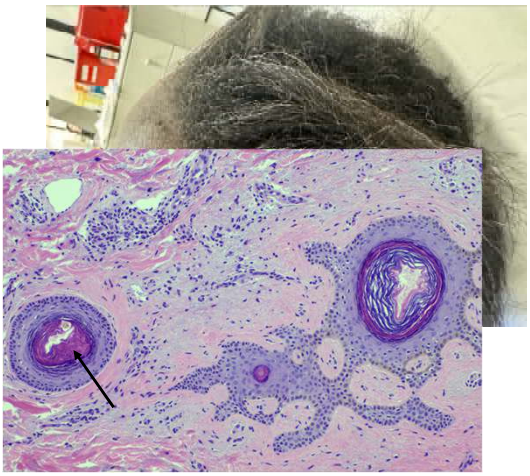
Inner Root Sheath Collapse (Upper Level)





27

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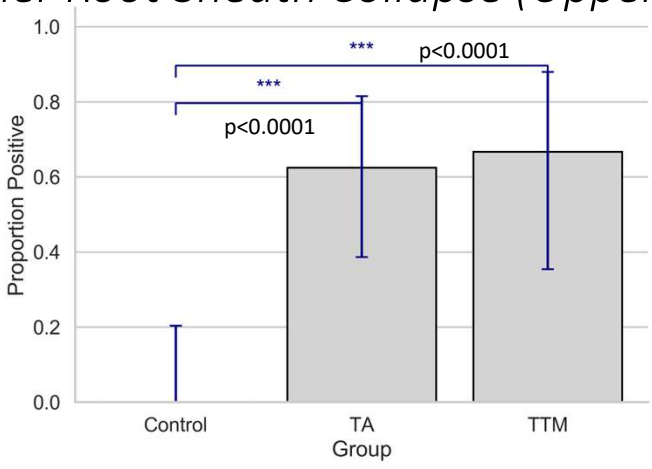

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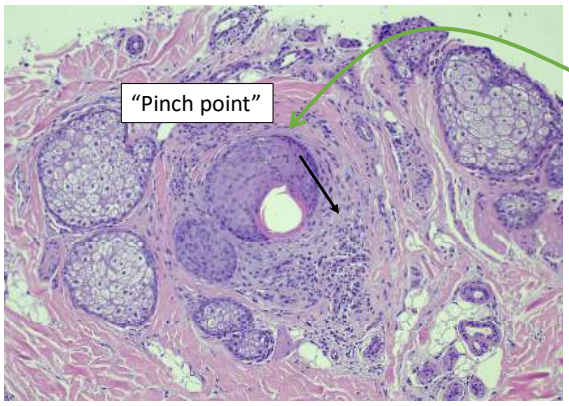
Lateral Impingement of the Follicular Canal



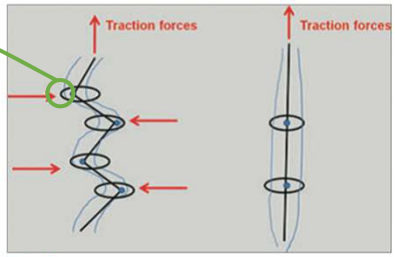


Figure 7: Diagram showing predisposition of curly African hair (left) to traction damage along its length versus straight Caucasian hair (right). (Points of weakness in red). Image from Miteva and Tosti, 2012[29] Copyright 2012 by John Wiley and Sons

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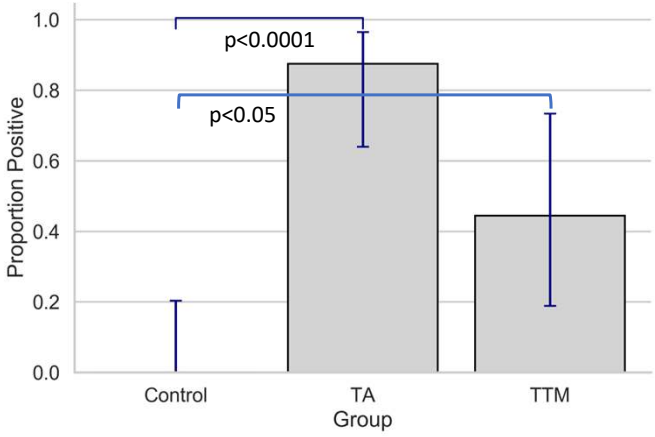

TA = traction alopecia
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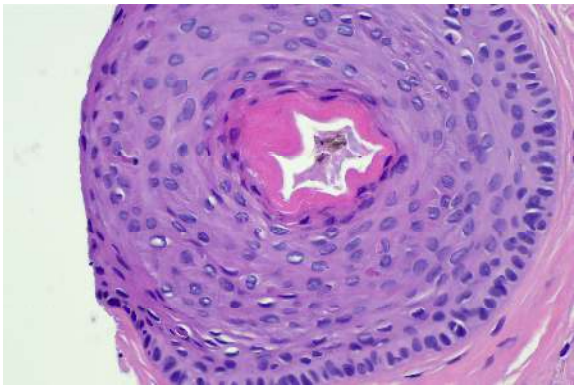
Inner Root Sheath Collapse (Lower Level)



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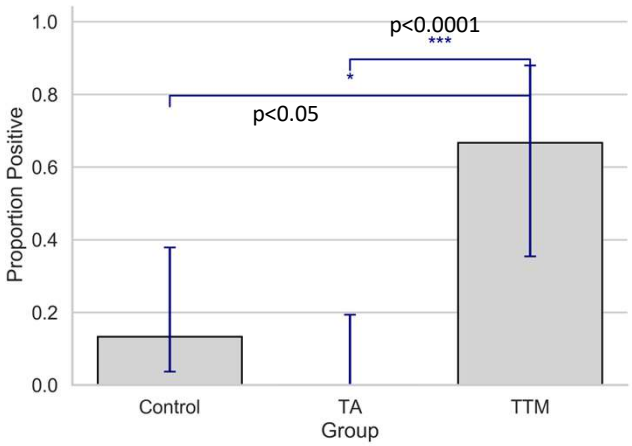
Inner Root Sheath Collapse (Lower Level)



TA = traction alopecia
TTM = trichotillomania

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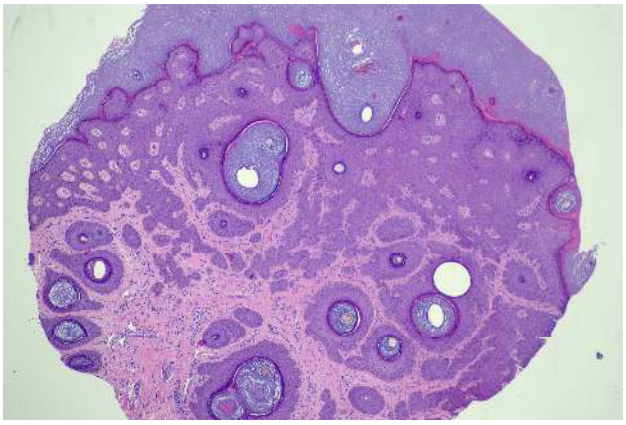
Surface Lichenification



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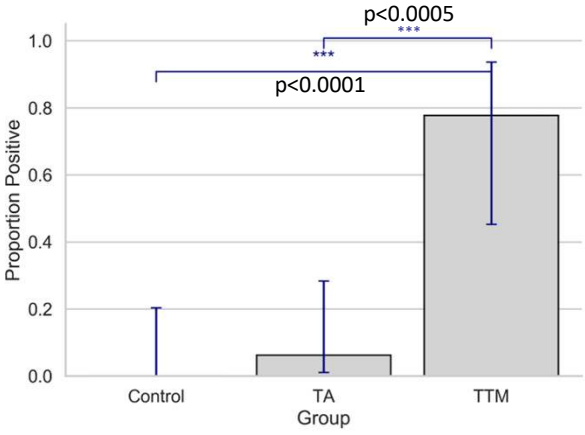
Surface Lichenification



TA = traction alopecia
TTM = trichotillomania

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Limitations

- Relatively small sample size
- Retrospective study
- Variation in site of biopsy on scalp
- All biopsies studied were processed horizontally
- Control specimens were not taken from same patient (although control included were from approximately age/gender matched individuals)

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Summary

- A history of mechanical traction on the pilosebaceous unit may leave histopathologic clues detectable in horizontally-processed scalp biopsy specimens
- The mechanism of tension may lead to differing histologic alterations
- Novel additional clues to traction alopecia:
  - Vectorially warped sebaceous lobules
  - Collapse of the IRS specifically at higher levels
  - Lateral impingement of the follicular canal
- Novel additional clues to trichotillomania:
  - Surface lichenification
  - Collapse of IRS specifically at lower levels
- No single histopathologic feature appears present in 100% of cases!

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Summary

Mechanical alopecia: Histologic clues *updated*

Traction Alopecia	1. Trichotillomania
1. Marked decrease in total number of follicles and terminal follicles with retention of vellus hairs 2. Pauci-follicular units 3. No significant inflammation 4. Fibrous streamers 5. Variably increased catagen/telogen hairs ***6. Vectorially-warped sebaceous lobules*** ***7. Collapse of the inner root sheath (upper isthmus)*** ***8. Lateral follicular impingement***	1. Trichomalacia 2. Pigmented hair casts 3. Peri- and Intrafollicular hemorrhage 4. "Hamburger sign" 5. Sebaceous lobule translocation to follicular canal 6. Variably increased catagen/telogen hairs 7. Collapse of the inner root sheath ***8. Surface lichenification***

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Thank you

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