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SCIENCE CATCHES UP WITH THE KENNEDY TERMINAL ULCER

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CONFLICT OF INTEREST DISCLOSURE

Karen Lou Kennedy-Evans

AND

Leslie Ritter

Have no commercial interest to report.



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LEARN TODAY / USE TOMORROW

Present Today: What concepts are you teaching/presenting about during your talk?

1. Learners will know how to recognize a Kennedy Terminal Ulcer
2. Learners will consider the use of objective skin temperature measurement when assessing all forms of skin failure
3. Learners' patients will be able to have earlier accurate detection of



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Science Catches Up With The "Kennedy Terminal Ulcer (Lesion)"



Photo Courtesy: Dot Wells

Kennedy Terminal Lesion



Photo Courtesy: KL Kennedy Evans

3:30 Syndrome



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1989 First NPUAP Conference (NPIAP)

- I was asked to present my research
 - 5 year retrospective study of the prevalence of pressure ulcers in a long-term care facility.
- Roberta Abbruzzee, RN – editor
 - Asked me to publish in Decubitus Magazine
 - (Advances in Skin and Wound Care)



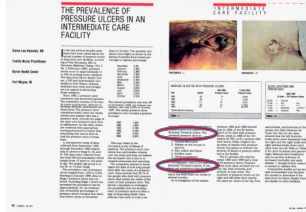
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What Did We Know Then? (1989)



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Retrospective Study



Now: Advances In Skin And Wound Care

= Kennedy Terminal Lesion



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Retrospective Study 1983 - 1988



1. Shaped like a pear
2. Always on the coccyx or sacrum
3. Red, yellow and black
4. Sudden onset
5. Death is imminent

Now: Advances In Skin And Wound Care



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Terminology

- Kennedy Terminal Lesion
 - Original article in 1989
- Morphed into:
 - Kennedy Terminal Ulcer
- With the medical advancements in past decades, patients frequently survive acute and or chronic conditions that once regulated them to immediate death.
 - Bain 2022
- Shortened to: Kennedy Lesion (KL)



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KL NOT Pressure

- Reported that KTU was skin failure, not a pressure ulcer. They noted that:
 - Breakdown resulted from:
 - Decreased perfusion
 - Ischemia
 - Multi-organ failure
 - Reitz and Schindler
 - KTUs occur because of vascular compromise, not pressure.
 - Yastrub 2010



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Time Frame

- With this particular lesion, in our experience, it has been from two weeks to months
 - Kennedy 1989
- In my experience, the typical range of time from initial presentation [KTU] to patient death is from a matter of hours to no more than 6 weeks.
 - Yastrub 2010



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How Did It Start?



1977



1983 - Skin And Wound Team



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Kennedy Lesion

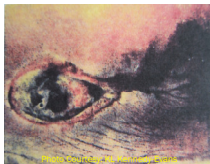


Photo Courtesy: KL Kennedy Evans

1983 - Before gloves and computers



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What Was Known - 1877

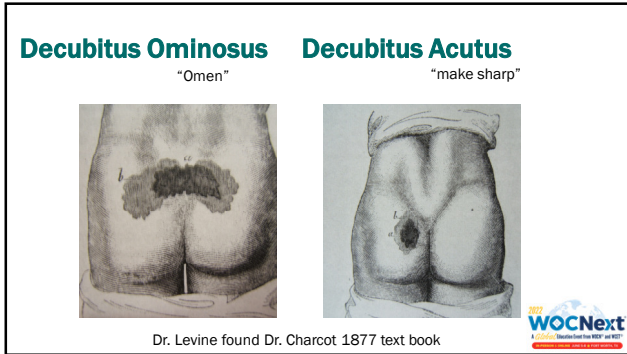


Jean Martin Charcot

- Salpetriere Hospital - Paris
 - 1862 started age 37
 - 1st to describe:
 - Parkinson's Disease
 - Multiple Sclerosis (MS)
 - Amyotrophic Lateral Sclerosis (ALS)
 - Charcot Foot
 - Now: Post Traumatic Stress Disorder PTSD
 - 1877 Text Book (15 years later)
 - 1882 Neurology Clinic (20 years later)
 - Greatest neurological clinic of the time in Europe
 - "Father of Neurology"
 - Attracted students from all parts of the world
 - Sigmund Freud



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145 Years Later

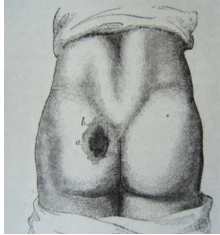


Photo Courtesy: KL Kennelby, RN



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Skin Failure - 2008

- An event in which the skin and underlying tissue die due to hypoperfusion that occurs concurrently with severe dysfunction or failure of other organ systems.
 - Acute skin failure
 - An event in which skin and underlying tissue die due to hypoperfusion concurrent with a critical illness.
 - Chronic skin failure
 - Occurs in conjunction with chronic disease
 - End-stage skin failure
 - Occurs at end of life, both due to hypoperfusion

Langemo and Brown 2008



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Skin Failure - 2022

- The state in which tissue tolerance is so compromised that cells can no longer survive in zones of:
 - physiological impairment:
 - includes hypoxia
 - local mechanical stresses
 - impaired delivery of nutrients
 - buildup of toxic metabolic byproducts
 - this includes pressure injuries
 - wounds that occur at life's end
 - in the setting of multisystem organ failure.
 - Levine, Delmore and Cox



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Sub Categories of End Stage Skin Failure

- KTU (Kennedy Terminal Ulcer)
- SCALE (Skin Changes at Life's End)
- TB-TTI (Trombley Brennan-Terminal Tissue Injury)

— Schank J. Making a Case for Retaining Kennedy Terminal Ulcer and Other End-of-Life Ulcer Terminology: A Review of the Literature, Wounds December 2021 ISSN 1044-7846 2021;33(12): 309-320



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What Did We Learn?

- 1876 - Decubitus Ominosus/Acutus (Dr. Charcot)
- 1989 - Kennedy Terminal Lesion/3:30 Syndrome (Kennedy)
- 1999 - F.R.A.I.L. (For the Recognition of the Adult Immobilized Life) (Alvarez et al.)
- 2005 - Dr. Charcot's textbook (Found by Dr. Levine)
- 2005 - Skin Failure (Langemo and Brown)
- 2008 - SCALE (Skin Changes at Life's End) (Sibbald, Krasner et al.)
- 2009 - Trombley-Brennan Terminal Tissue Injury
- 2022 - Skin Failure (Levine, Delmore and Cox)



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What Do We Know NOW? 2022

- Thermography:
 - Early detection of skin discoloration in the KL are not associated with a temperature change
 - Skin temperatures change in pressure injuries
 - Skin temperatures may be a clue to the changes in different lesions.
 - We can be more precise in describing the pathophysiology of different forms of skin lesions



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What Does That All Mean?

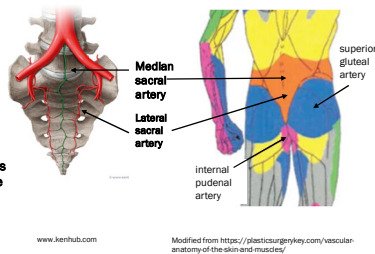
- Leslie Ritter, PhD, RN, FAAN, FAHA
- Professor Emerita, College of Nursing, University of Arizona



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The skin vasculature

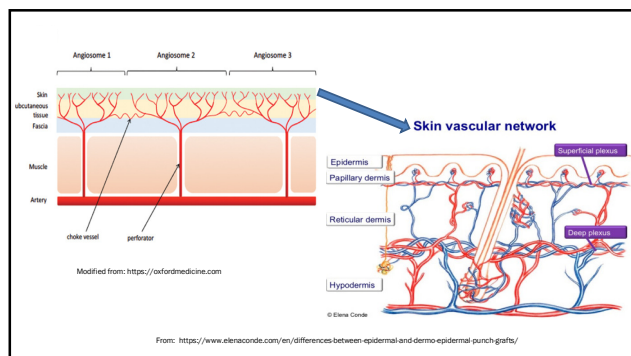
- Skin of the sacrum is supplied primarily by the median sacral and lateral sacral arteries, branches of the internal iliac arteries
- Skin is part of an angiosome
 - An anatomic unit of tissue consisting of **skin, subcutaneous tissue, fascia, muscle, and bone** fed by a source artery and drained by specific veins



www.kennhub.com

Modified from <https://plasticsurgerykey.com/vascular-anatomy-of-the-skin-and-muscles/>

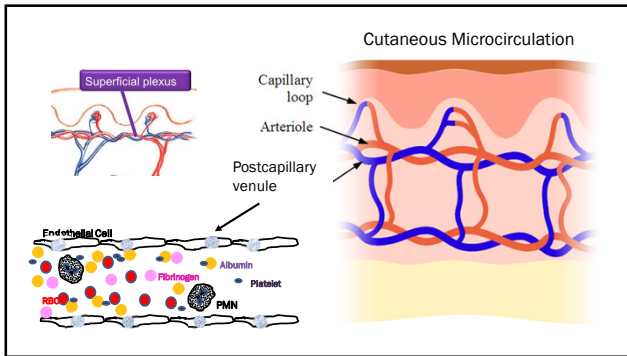
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Modified from: <https://oxfordmedicine.com>

From: <https://www.ehlersanderson.com/en/differences-between-epidermal-and-dermo-epidermal-punch-grafts/>

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Is skin temperature linked to skin injury?

- The majority of studies using objective measures of temperature in skin injuries have been primarily limited to diabetic ulcers and Pressure Injuries (PIs)²⁻⁵
- Objective (non-tactile) temperature measurements
 - Adhesive temperature strips, taped thermocouple skin probe, handheld infrared thermography, mobile phone-based infrared thermography.
- Timing of measurements
 - Combination of before, during or after the discoloration first observed



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Is skin temperature linked to skin injury?

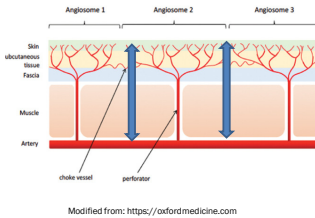
- International Guideline Recommendation 2.4 is to "Assess temperature of skin and soft tissue" and "Consider using an infrared thermographic imaging device or infrared thermometer as an adjunct to clinical examination of the skin."¹
- Objective measures of skin temperature are not widely used in clinical practice



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Skin temperature changes in Pressure Injuries³⁻⁵

- Temperature findings within areas of intact discolored skin
 - Temperature changes over areas of inflammation or hyperemia are warmer than surrounding skin
 - Temperature changes over areas of ischemia are cooler than surrounding skin
 - In PI, skin temperature changes may reflect injury across subunits of the angiosome(s)



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What about skin temperature of Kennedy Terminal Ulcer (KTU)?

- KTU, originally coined the Kennedy Lesion (KL)⁶
 - Intact skin discoloration that occurs suddenly
 - Generally has the shape of a butterfly, pear or horseshoe with irregular borders
 - Mostly deep red and/or purple in color
 - Occurs primarily in the sacrococcygeal area but can occur elsewhere
 - Generally associated with death within weeks or months
- Temperature characteristics of the KL have not been reported



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Early Skin Temperature Characteristics of KL

- Purpose
 - The purpose of this study was to describe early skin temperature changes in KLs using as objective measure of skin temperature
- Design and Methods
 - KLs were identified from chart review in ten ICU patients
 - Demographic information was collected when available
 - Skin assessments were performed within 24 hours of new skin discoloration by a certified wound care clinician; time frame defined as "early"
 - Temperature measurements were performed using a long wave infrared thermography (LWIT) imaging system
 - Relative Temperature Differential (RTD) between the discolored area and a selected control point was calculated
 - RTDs $\geq +1.2^{\circ}\text{C}$ and $\leq -1.2^{\circ}\text{C}$ were considered abnormal³⁻⁵



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

LWIT imaging and data collection process

1. Position patient to expose image area (remove any clothing or dressing to the area). Acclimate the tissue to room area.

2. Align camera lasers pointed proximal to the image area (to standardize 18-inch distancing) for accurate measurement.

3. With camera pointed 90-degree to the image area, pull trigger to simultaneously produce digital and mirror thermal image


4. Software produces temperature and size measurement from trace outline.

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Early Skin Temperature Characteristics of KL

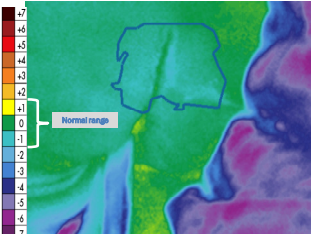
- **Major finding**
 - Within 24 hours of the first observable skin discoloration, skin temperatures of all ten KTU/KLs were normal
 - RTD
 - Range -1.0 °C to +0.5 °C
 - Mean (SD) 0.4 °C (0.5°C)
- Additional findings
 - Observable characteristics of the KTU/KL were confirmed
 - Demographics (selected)
 - > 3 co-morbidities
 - Hgb, Hct, albumin values were low
 - Vasopressors in use
 - > 60 yrs old
 - LWIT is an objective, reliable measure of skin temperature that can easily be used at the bedside by trained clinicians



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Visual image (left) shows KL discoloration. Thermal image (right) shows the blue traced area with a normal mean temperature (RTD -0.6 C°)





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Early Skin Temperature Characteristics of KL (con't)

- What explains the early normal skin temperature findings in the KL?
- First, it is important to understand the risk factors contributing to KL
- In a 2022 concept review, Levine describes KTU (KL) as an injury within the "spectrum of skin failure." As such, risk factors of KLs parallel those of skin failure.⁷



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Risk factors for skin failure and KL

- multiple organ dysfunction
- hypotension
- Use of vasopressors
- Use of mechanical ventilation
- Co-morbid conditions (e.g., cardiovascular disease, smoking, diabetes, pneumonia, sepsis)
- abnormal white cell counts
- Malnutrition/low albumin levels
- immobility
- aging



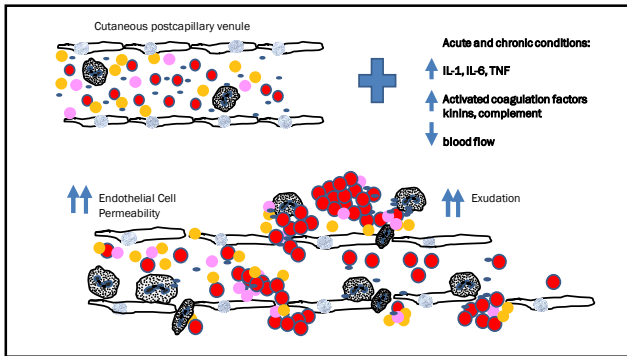
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Skin Microcirculation Injury Hypothesis

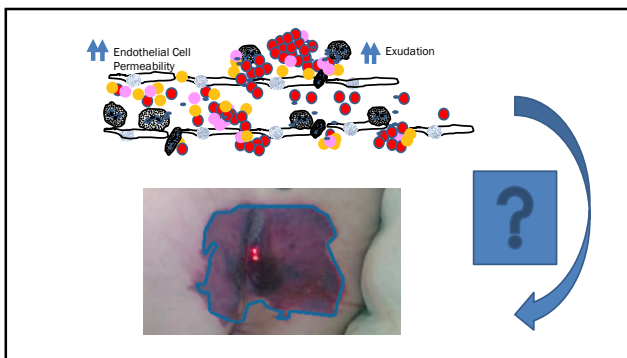
- Acute and chronic conditions can result in release of **cytokines** from multiple cell types and **activation of plasma complement, kinin and coagulation systems** that contribute to endothelial **damage of the postcapillary venule**
- These conditions **activate circulating immune cells**, specifically, neutrophils and monocytes
- When activated, these immune cells adhere to the already damaged endothelium of the postcapillary venule and release **more cytokines such as interleukins (e.g., IL-1, IL-6), TNF α and IFN γ** .
- As a result of these inflammatory processes, **postcapillary venules become structurally unsound and highly permeable**



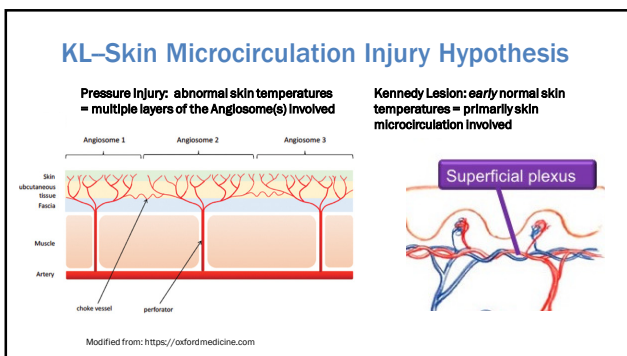
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Summary

- In contrast to findings in Pressure Injury, in this small study *early* skin temperatures of the KL were normal.
- Inflammatory processes in the postcapillary venule may play a predominant role in early KTU/KL injury.
- It may be that endothelial damage in the postcapillary venule reaches a point at which microcirculatory breakdown occurs, leading to significantly increased permeability and subsequent outward leakage of blood components.
- It is at this critical point when the sudden, observable superficial skin discoloration of the KL might occur, however, *because surrounding tissue is not yet ischemic or inflamed, no skin temperature abnormalities are observed.*
- Larger studies are needed to confirm these findings and to track temperature characteristics over time.



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Thank You!

- Study co-authors
 - Karen Lou Kennedy-Evans, Deanna Vargo, Diane Adams, Suzanne Koerner
- Kennedy Terminal Ulcer Foundation
- Wound Care Teams and patients in study hospitals
- WOCNext 2022



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