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Hydration, Its Role In Wound Healing

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1. INTRODUCTION

All biological processes require water and balancing of moisture levels is key to maintaining the ideal state. There are several mechanisms responsible for maintaining the ideal moisture balance in skin. Wounding disrupts this hydration balance. Evidence suggests that a moist wound environment and maintenance of tissue hydration aids healing, clinical experience with chronic wounds suggests that excessive wound exudate is damaging to the wound and surrounding skin.

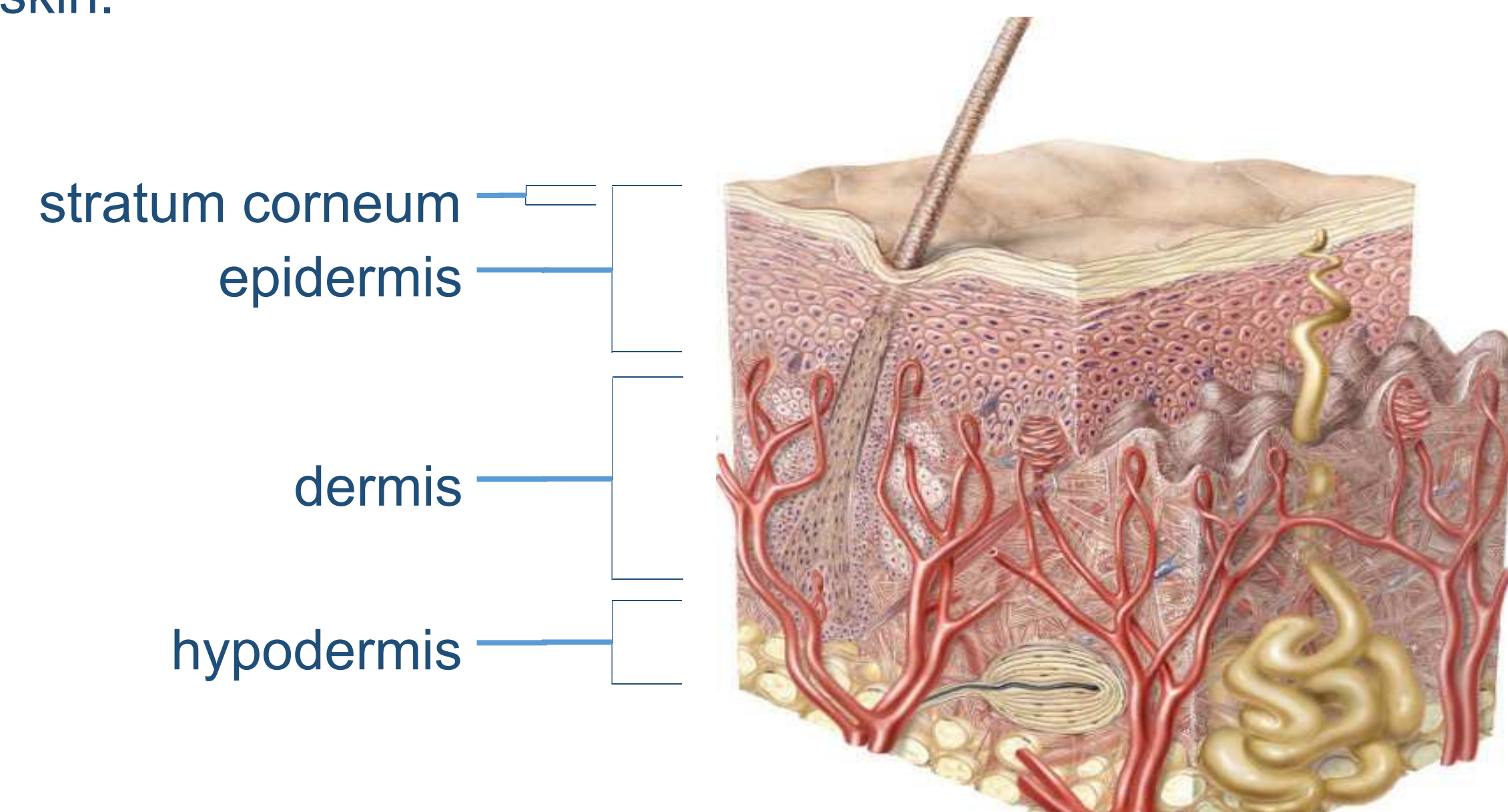


Figure 1: structure of the skin

2. HYDRATION IN SKIN

The outermost layers of the skin, the epidermal stratum corneum, are important for maintenance of skin hydration¹ (Figure 1). Both the physical structure and its chemical composition are key to water retention within the epidermis. Water also plays an important role in the normal functioning of the skin itself. Fluid retention in skin also depends upon the maintenance of an optimal skin hydration level². The dynamic supply (via blood circulation) and removal of fluid (via lymphatic system drainage) from the skin is an ongoing process and any disruption in this fine balance can result in clinical problems. For example, uncontrolled influx or deficient removal of water can lead to tissue oedema. The uncontrolled loss of water as a result of a breach in the skin's integrity (i.e., wounding) can result in tissue dehydration.

3. WOUND HEALING AND HYDRATION

Optimal wound healing is very dependent upon the appropriate level of tissue hydration² and it has been suggested to be the single most important external factor³. Skin wounding results in an imbalance of the skin's hydration status and exposure of tissues to air leads to tissue drying. The disruption of blood vessels and the increased outflow of fluid in an attempt to maintain moisture balance leads to exudate formation.

The initiation of the blood coagulation system quickly "plugs" the open wound to limit fluid loss and to protect tissues from bacterial contamination. Once plugged, wound healing can commence.

4. MOIST WOUND HEALING

Skin wounds exposed to air dry out. This drying of the wound and the initiation of the blood coagulation system leads to the formation of a wound scab/eschar. Landmark studies from George Winter in the 1960s showed that wounds exposed to air and allowed to dry healed poorly when compared to wounds kept moist⁴. Numerous studies performed since Winter's early work has provided evidence of the benefits of a moist wound healing environment (see Table)⁵. The adoption of the concept of moist wound healing in wound care has led to the development of a number of types of modern wound dressings, all designed to manage various levels of exudate. More recently, some dressings have been developed to help balance and maintain an optimised level of wound hydration (Figure 2). Clinical experience in chronic wound management, however, has suggested that excessive levels of fluid in and around the wound are detrimental to positive clinical outcomes, resulting in tissue maceration, skin reddening and tissue damage.

1 Madison KC. (2003). Barrier function of the skin: "la raison d'être" of the epidermis. *Journal of Investigative Dermatology* 121(2): 231-241.

2 Bishop SM, Walker M, Rogers AA, Chen WYJ. (2003). Importance of moisture balance at the wound-dressing interface. *Journal of Wound Care* 12(4): 125-128.

3 Atiyeh BS, Hayek SN. (2005). Intérêt d'un onguent chinois (MEBO) dans le maintien local de l'humidité. *Journal des Plaies et Cicatrisation* 9: 7-11.

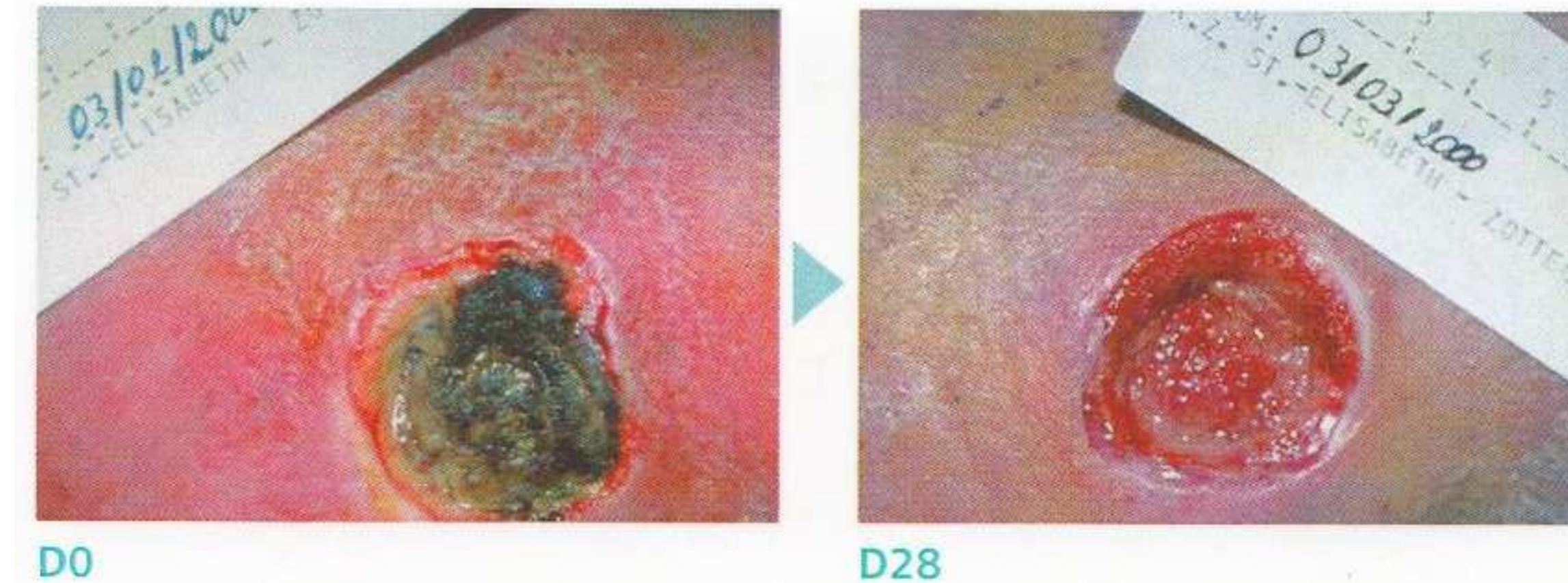


Figure 2: Mechanical debridement in combination with application of wound dressing which optimises wound hydration, resulting in wound cleansing and progression. (Photo courtesy of F. Meuleneire, Belgium)

5. WET WOUND HEALING

Despite the assumption that excessive hydration of wounds should be avoided, several studies have suggested that wet wound healing, i.e., the presence of free fluid at the wound site, may be beneficial for wound healing. The immersion of wounds with saline or cell culture solutions to create "wet wounds" results in enhanced wound healing, reduced tissue necrosis and scarring compared with dry wounds. Wet wounds show little evidence of tissue maceration.

Benefits of moist wound healing

- Faster wound healing
- Promote epithelialisation rate
- Promote dermal/wound bed healing responses
- Reduced scarring
- Retention of growth factors to wound site
- Lower infection rates
- Reduced pain perception
- Enhanced autolytic debridement

4 Winter GD. (1962). Formation of the scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. *Nature (London)* 193: 293-294.

5 Junker JP, Kamel RA, Caterson EJ, Eriksson E. (2013). Clinical impact upon wound healing and inflammation in moist, wet, and dry environments. *Advances In Wound Care* 2(7): 348-356.

6 McCarty SM, Percival SL. (2013). Proteases and delayed wound healing. *Advances In Wound Care* 2(8): 438-447.

6. WOUND HYDRATION IS GOOD?

Optimising the hydration/moisture balance of the wound optimises healing. Both moist and wet wound healing offers significant healing benefits compared with dry wound healing. The clinical experience of excessive wound hydration being damaging to tissue and the studies suggesting that wet wounds heal with similar benefits previously ascribed to moist healing seem, at first glance, to be contradictory. However, this information, together with the knowledge that chronic wound exudates are fundamentally different from acute wounds, offers an explanation for the apparent contradiction. Chronic wound exudates contain high levels of protein-degrading enzymes and other tissue-damaging components that are able to damage tissues⁶. Acute wounds, however, contain low and controllable levels of these components that are little able to act on tissues. Chronic wound exudates damage tissues because of these components and not as result of exposure to the water itself..



Figure 3: schematic of dressing action

7. CONCLUSION: WOUND DRESSINGS AND HYDRATION

Wound hydration levels are important for wound healing. Optimising moisture balance is a key property of modern wound dressings. Recently, wound dressings better able to manage both the fluid levels and the damaging components contained within chronic wound exudate are better placed to manage these damaging fluids effectively. Dressings are now available that manage both of these sides to chronic wound exudate but are now able to donate "fresh" solutions (e.g., Ringer's solution) from the dressings, further optimising hydration levels at the wound site and enhancing the healing benefits of a hydrated wound (Figure 3).