Wound Care: Advanced Therapies for Wound Intervention

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MY DISCLOSURES

Employed by Medtrition manufacturer of wound care protein products

LEARNING OBJECTIVES

- Will be able to identify NPIAP 2019 International Guidelines for treatment of pressure ulcers/injuries.
- Will be able to define recommended energy and protein intake for patients with pressure injuries.
- Will be able to define the difference between proteins, amino acids and dipeptides and how they impact the wound healing process.

Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline

The International Guideline 2019

EUROPEAN PRESSURE ULCER ADVISORY PANEL

NPIAP℠ NATIONAL PRESSURE INJURY ADVISORY PANEL
Improving Patient Outcomes Through Education, Research and Public Policy

PAN PACIFIC Pressure Injury Alliance

Accessing the Guideline and Support Material

Access to digital and print copies of the *Clinical Practice Guideline* are available on the following websites:

NPIAP website	www.npiap.com
EPUAP website	www.epuap.org
PPPIA website	www.pppia.org
International Pressure Injury Guideline website	www.internationalguideline.com

The International Pressure Injury Guideline website (www.internationalguideline.com) is accessible until the next guideline revision. The website hosts additional supportive material including:

NPAIP Guidelines for Wound Assessment and Monitoring

10.3: Conduct a comprehensive reassessment of the individual if the pressure injury does not show some signs of healing within two weeks despite appropriate local wound care, pressure redistribution, and nutrition.
(Strength of Evidence = B2, Strength of Recommendation = ↑↑)

Pressure Ulcer Assessment and Monitoring

10.4: Assess the pressure injury initially and re-assess at least weekly to monitor progress toward healing.
(Good practice statement)

Assessing and Monitoring the Size of the Pressure Injury

10.5: Select a uniform, consistent method for measuring pressure injury size and surface area to facilitate meaningful comparisons of wound measurements across time.
(Strength of Evidence = B2, Strength of Recommendation = ↑↑)

Tools for Monitoring Pressure Injury Healing

10.7: Monitor the pressure injury healing progress.
(Good Practice Statement)

10.8: Consider using a validated tool to monitor pressure injury healing.
(Strength of Evidence = B2, Strength of Recommendation = ↑)

Table 13.2: Pressure injury assessment and monitoring tools

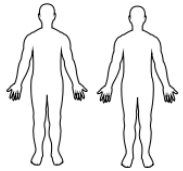
	Pressure injury specific	Tool Description	Psychometric Properties
DESIGN-R[73]	Yes	7 items scored on numeric/ description scales that combine to produce an overall severity score	• Strong correlation with BWAT (correlational co-efficient = 0.91)[70] • Interrater reliability when assessing clinical wounds, r = 0.91[70] • Interrater reliability when assessing photographed wounds, r = 0.94[70]
Bates-Jensen Wound Assessment Tool (BWAT)[74]	Yes	15 items (13 wound characteristics scored on a Likert scale and 2 unscored items)	• Interrater reliability when assessing clinical wounds, ICC = ranged from 0.78[68] to 0.92[69] • Intrarater reliability when assessing clinical wounds, ICC = ranged from 0.89[68] to 0.99[69] • Moderate correlation with Category/Stage of pressure injury (r = 0.55, p = 0.001)[77] • Strong correlation with PUSH©, with correlation increasing in repeated measures over time (r = 0.72 to 0.95)[66]
Pressure Ulcer Scale for Healing (PUSH©)[75]	Yes	3 items scored on numeric/ description scales that combine to produce an overall total healing score	• Total PUSH© score explains 31% of variation in pressure injury over time[67] • Good correlation with wound tracings (r = 0.63, p = 0.01)[72] • Strong correlation with BWAT, with correlation increasing in repeated measures over time (r = 0.72 to 0.95)[66]
Spinal Cord Impairment Pressure Ulcer Monitoring Tool (SCI-PUMT)[76]	Yes	7 items scored on numeric/ description scales that combine to produce an overall severity score	• Interrater reliability when assessing clinical wounds, r= 0.79[78] • Intrarater reliability when assessing clinical wounds, r= 0.81 to 0.99[78]

PSST

Complete the rating sheet to assess wound status. Evaluate each item by picking the response that best describes the wound and entering the score in the item score column for the appropriate date.

Location: Anatomic site. Circle, identify right **(R)** or left **(L)** and use **"X"** to mark site on body diagrams:

____ Sacrum & coccyx ____ Lateral ankle
____ Trochanter ____ Medial ankle
____ Ischial tuberosity ____ Heel Other Site



Shape: Overall wound pattern; assess by observing perimeter and depth.

Circle and date appropriate description:

____ Irregular ____ Linear or elongated
____ Round/oval ____ Bowl/boat
____ Square/rectangle ____ Butterfly Other Shape

Item	Assessment	Date Score	Date Score	Date Score
1. Size	1 = Length x width <4 sq cm 2 = Length x width 4-<16 sq cm 3 = Length x width 16.1-<36 sq cm 4 = Length x width 36.1-<80 sq cm 5 = Length x width >80 sq cm			
2. Depth	1 = Non-blanchable erythema on intact skin 2 = Partial thickness skin loss involving epidermis &/or dermis 3 = Full thickness skin loss involving damage or necrosis of subcutaneous tissue; may extend down to but not through underlying fascia; &/or mixed partial & full thickness &/or tissue layers obscured by granulation tissue 4 = Obscured by necrosis 5 = Full thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone or supporting structures			
3. Edges	1 = Indistinct, diffuse, none clearly visible 2 = Distinct, outline clearly visible, attached, even with wound base 3 = Well-defined, not attached to wound base 4 = Well-defined, not attached to base, rolled under, thickened 5 = Well-defined, fibrotic, scarred or hyperkeratotic			
4. Under-mining	1 = None present 2 =Undermining < 2 cm in any area 3 = Undermining 2-4 cm involving < 50% wound margins 4 = Undermining 2-4 cm involving > 50% wound margins 5 = Undermining > 4 cm or Tunneling in any area			
5. Necrotic Tissue Type	1 = None visible 2 = White/grey non-viable tissue &/or non-adherent yellow slough 3 = Loosely adherent yellow slough 4 = Adherent, soft, black eschar 5 = Firmly adherent, hard, black eschar			
6. Necrotic Tissue Amount	1 = None visible 2 = < 25% of wound bed covered 3 = 25% to 50% of wound covered 4 = > 50% and < 75% of wound covered 5 = 75% to 100% of wound covered			
7. Exudate Type	1 = None			

Item	Assessment	Date Score	Date Score	Date Score
	2 = Bloody 3 = Serosanguineous: thin, watery, pale red/pink 4 = Serous: thin, watery, clear 5 = Purulent: thin or thick, opaque, tan/yellow, with or without odor			
8. Exudate Amount	1 = None, dry wound 2 = Scant, wound moist but no observable exudate 3 = Small 4 = Moderate 5 = Large			
9. Skin Color Sur-rounding Wound	1 = Pink or normal for ethnic group 2 = Bright red &/or blanches to touch 3 = White or grey pallor or hypopigmented 4 = Dark red or purple &/or non-blanchable 5 = Black or hyperpigmented			
10. Peripheral Tissue Edema	1 = No swelling or edema 2 = Non-pitting edema extends <4 cm around wound 3 = Non-pitting edema extends ≥4 cm around wound 4 = Pitting edema extends < 4 cm around wound 5 = Crepitus and/or pitting edema extends ≥4 cm around wound			
11. Peripheral Tissue Induration	1 = None present 2 = Induration, < 2 cm around wound 3 = Induration 2-4 cm extending < 50% around wound 4 = Induration 2-4 cm extending ≥ 50% around wound 5 = Induration > 4 cm in any area around wound			
12. Granu-lation Tissue	1 = Skin intact or partial thickness wound 2 = Bright, beefy red; 75% to 100% of wound filled &/or tissue overgrowth 3 = Bright, beefy red; < 75% & > 25% of wound filled 4 = Pink, &/or dull, dusky red &/or fills ≤ 25% of wound 5 = No granulation tissue present			
13. Epithe-lializa-tion	1 = 100% wound covered, surface intact 2 = 75% to <100% wound covered &/or epithelial tissue extends >0.5cm into wound bed 3 = 50% to <75% wound covered &/or epithelial tissue extends to <0.5cm into wound bed 4 = 25% to < 50% wound covered 5 = < 25% wound covered			
	TOTAL SCORE			
	SIGNATURE			

WOUND STATUS CONTINUUM

1 5 10 **13** 15 20 25 30 35 40 45 50 55 **60**

Tissue Health — **Wound Regeneration** — **Wound Degeneration**

Plot the total score on the Wound Status Continuum by putting an **"X"** on the line and the date beneath the line. Plot multiple scores with their dates to see-at-a-glance regeneration or degeneration of the wound.

NATIONAL PRESSURE ULCER ADVISORY PANEL

Pressure Ulcer Scale for Healing (PUSH)
PUSH Tool 3.0

Patient Name _____ Patient ID# _____

Ulcer Location _____ Date _____

Directions:

Observe and measure the pressure ulcer. Categorize the ulcer with respect to surface area, exudate, and type of wound tissue. Record a sub-score for each of these ulcer characteristics. Add the sub-scores to obtain the total score. A comparison of total scores measured over time provides an indication of the improvement or deterioration in pressure ulcer healing.

LENGTH X WIDTH (in cm^2)	**0** 0	**1** < 0.3	**2** 0.3 – 0.6	**3** 0.7 – 1.0	**4** 1.1 – 2.0	**5** 2.1 – 3.0	**Sub-score**
		6 3.1 – 4.0	**7** 4.1 – 8.0	**8** 8.1 – 12.0	**9** 12.1 – 24.0	**10** > 24.0	
EXUDATE AMOUNT	**0** None	**1** Light	**2** Moderate	**3** Heavy			**Sub-score**
TISSUE TYPE	**0** Closed	**1** Epithelial Tissue	**2** Granulation Tissue	**3** Slough	**4** Necrotic Tissue		**Sub-score**
							TOTAL SCORE

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NPIAP Guidelines for Nutritional Treatment

Energy and Protein Intake for Individuals with Pressure Injuries

4.6: Provide 30 to 35 kcalories/kg body weight/day for adults with a pressure injury who are malnourished or at risk of malnutrition.
(Strength of Evidence = B1; Strength of Recommendation = ↑)

4.7: Provide 1.25 to 1.5 g protein/kg body weight/day for adults with a pressure injury who are malnourished or at risk of malnutrition.
(Strength of Evidence = B1; Strength of Recommendation = ↑↑)

4.8: Offer high calorie, high protein fortified foods and/or nutritional supplements in addition to the usual diet for adults who are at risk of developing a pressure injury and who are also malnourished or at risk of malnutrition, if nutritional requirements cannot be achieved by normal dietary intake.
(Strength of Evidence = C; Strength of Recommendation = ↑)

4.9: Offer high calorie, high protein nutritional supplements in addition to the usual diet for adults with a pressure injury who are malnourished or at risk of malnutrition, if nutritional requirements cannot be achieved by normal dietary intake.
(Strength of Evidence = B1; Strength of Recommendation = ↑↑)

4.10: Provide high-calorie, high-protein, arginine, zinc and antioxidant oral nutritional supplements or enteral formula for adults with a Category/Stage II or greater pressure injury who are malnourished or at risk of malnutrition.
(Strength of Evidence = B1; Strength of Recommendation = ↑)

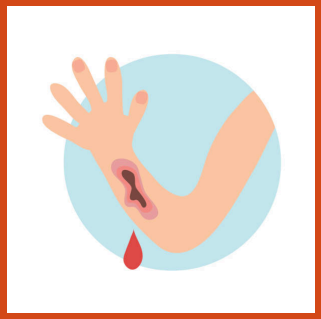
PRESSURE INJURY AND MALNUTRITION

- Admission to ICU and advanced age are two of the highest risk factors for both pressure injury and malnutrition
- Prevalence of pressure injury: ICU=28.7% and Acute Care=21.6%
- Malnourished patients are at 200%–500% higher risk for pressure injuries
- “>91% of subjects transferred from acute care to sub-acute were either malnourished or at risk of malnutrition”

IHI.org
Whittington K, et al. *J WOCN.* 2000;27:209–215.
Banks M, Bauer J, Graves N, et al. *Nutrition.* 2010;26:896-901.
Thomas DR, et al. *Am J Clin Nutr.* 2002;75:308-13.

NUTRITIONAL GOALS FOR WOUND HEALING

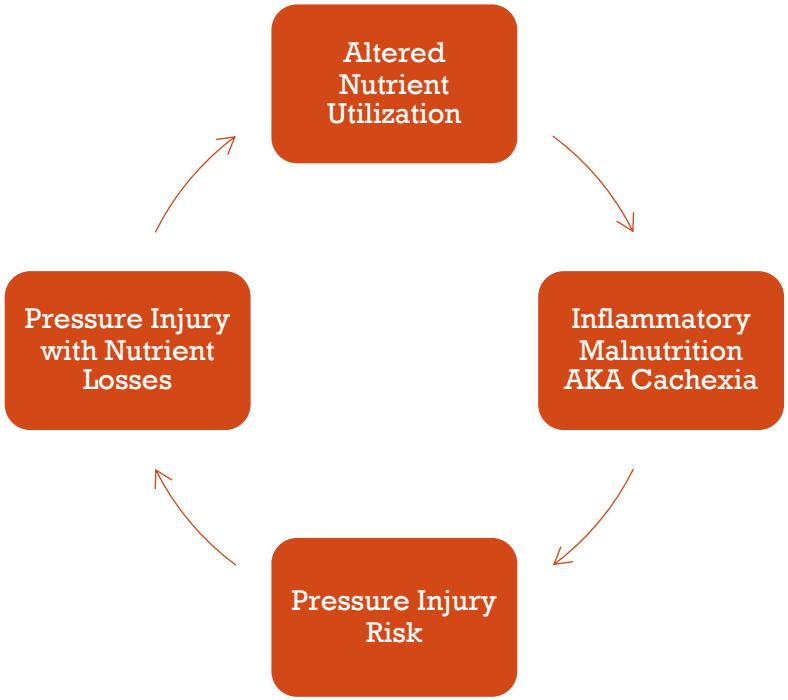
- Early intervention to maintain gut integrity and decrease risk pressure injuries and poor surgical wound healing
- Provide adequate and appropriate nutrition to support healing, modulate inflammation and prevent/correct deficiencies
- Tight glycemic control
- Good tolerance to intervention



SCCM and ASPEN Critical Care Nutrition Guidelines, *JPEN*. 2009;http://pen.sagepub.com/content/33/3/277

MAKING THE CONNECTION INFLAMMATION-MALNUTRITION-WOUNDS

Inflammatory Triggers



Acute Inflammatory Response/ Hypermetabolic State- **2-25 days Post Injury**

1. Assessment of a prognostic biochemical indicator of nutrition and inflammation for pressure ulcer risk. Reynolds et al. J Clin Pathol.2006; 59: 308-310

INFLAMMATORY CONDITIONS WITH NUTRITIONAL IMPLICATIONS SAME AS RISKS FOR PRESSURE INJURIES

- Aging
- Burns, Trauma, Surgery
- Hyperglycemia
- Immobility
- Infections, Fever, Sepsis
- Long-bone fractures
- Periodontal Disease
- Pressure Injuries

- **Chronic/Acute illness**: Diabetes, Obesity, Cardio Vascular Disease, Chronic Kidney Disease, End Stage Renal Disease, etc
- Prolonged steroids

RISK FACTORS FOR MALNUTRITION (TWO OR MORE)

- Insufficient energy intake
- Unintended weight loss
- Loss of muscle mass
- Loss of subcutaneous fat
- Localized or generalized fluid accumulation
- Decreased functional status

KEY NUTRIENTS TO SUPPORT THE PHASES OF WOUND HEALING

Key Nutrients

- **Adequate Protein, Calorie, Fluids**
- Vitamin A, C and E, Copper, Magnesium & Zinc
- Arginine and Glutamine
- Antioxidants
  - Most vitamins and minerals and some amino acids
- Same key nutrients for surgical wounds

Stechmiller JK. *Nutr Clin Pract.* 2010;25:61-68.

IMPORTANCE OF ADEQUATE PROTEIN

- Adequate protein stores help control inflammation
- Deficiency can affect all phases of healing
  - Prolonged inflammation
  - ↓ collagen synthesis
  - Inhibits antibody responses (could increase risk of infection)
  - ↓ wound contraction
- Healing impairment may occur early, before standard measures indicate deficiency

Don't wait to initiate (intervention)!

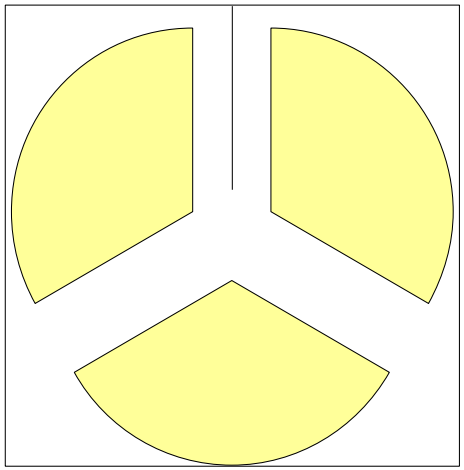
SYNERGY

Glutamine + Arginine

Conditionally Essential Amino Acids needed for metabolic stress

Vitamin & Minerals+

Prevent Deficiency & Antioxidants to Reduce Oxidative Stress



Adequate Fluids

Adjust per assessment

Additional Protein

Adequate, not excessive calories

ARGININE

- Conditionally essential amino acid
- Arginine enhances gut **AND** wound perfusion
  - Helps increase blood flow and oxygen to the wound site thus increasing collagen formation
- Arginine improves nitrogen balance which is essential for wound healing
  - Arginine converts to nitric oxide

Caution: Not recommended in ICU specifically for septic patients

May be contraindicated for those with renal disease

Barbul., et al. Arginine enhance wound healing and lymphocyte immune response in humans. Surg 108, 331-337, 1990. Kiyama A., et al. Trauma and wound healing: role of the route of nutritional support. J. Surg. Invest., 2, 483-489, 2001. **Witte et al., Metabolism,51, 1269-1272, 2002**

GLUTAMINE

- Conditionally essential amino acid
- Most abundant amino acid in the body
- Glutamine is an important source of fuel for rapid turnover of cells
  - Necessary during the stages of wound healing
- Glutamine helps improve/ maintain gut integrity and thus enhances nutrient absorption and utilization

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- **Caution:** Currently not recommended in ICU per ASPEN Critical Care Guidelines
- May be contraindicated for those with liver disease

REMEMBER….

- Adequate arginine supplies requires adequate glutamine, and both arginine and glutamine require adequate protein and micronutrients.
- **Foundational nutrition intervention is KEY**

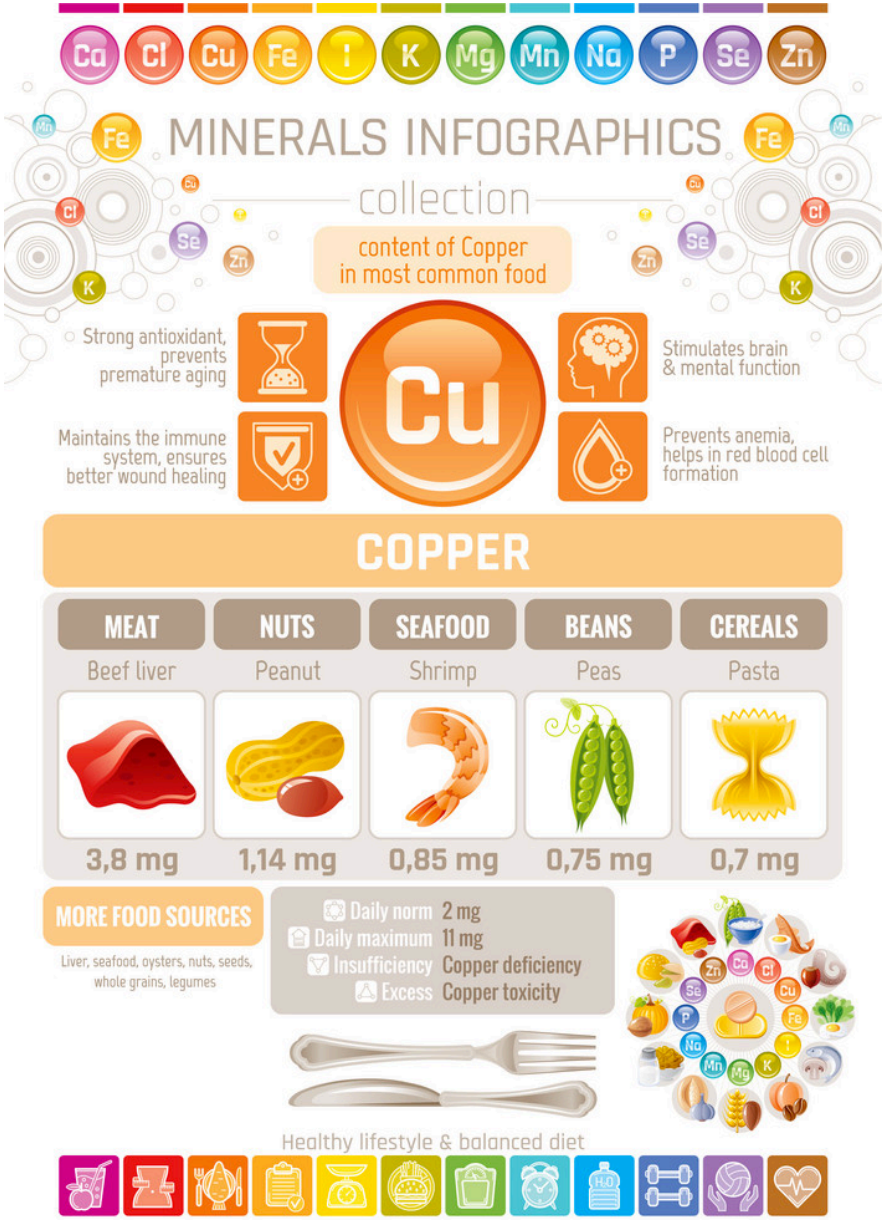
ZINC AND WOUND HEALING

- Cell proliferation, immunity, growth factors
- Competes with Copper & Copper competes with Zinc
  - Give 2 mg of Copper per 25 mg of Zinc, but do not give more than 4 mg of Copper per day.
- ***Upper limit for healthy adults – 40mg/d***
- Those at Risk for Deficiency
  - Bowel disease, sickle cell anemia, IDDM, ileostomy/fistula, draining wounds, diuretics, chelating agents, thyroid disease, alcoholic cirrhosis, skin loss

Don't wait to initiate (intervention)!

COPPER

- Copper is essential for collagen cross linking
- Copper supplementation may be necessary to help balance the zinc- copper ratio and prevent deficiency/ toxicity



ZINC- COPPER RELATIONSHIP

- Excessive zinc supplementation is not recommended because it can negatively affect copper status causing anemia
- The ideal ratio for zinc to copper when supplementing is ~10:1 respectively
- This is especially important for those requiring long term supplementation

SIMPLISTICALLY - Copper is essential for absorbing iron in the gut- if there is too much zinc, it can cause a copper deficiency and thus anemia

VITAMIN C

- Vitamin C is necessary for collagen synthesis
- It is essential for tissue repair and regeneration
- Aids in the absorption of iron and the activation of copper and protein metabolism
- Vitamin C is also a powerful antioxidant to assist in the inflammatory process and enhance the immune response

*Caution in renal population- NKF recommends no more than 60-100mg Vitamin C per day for those with CKD

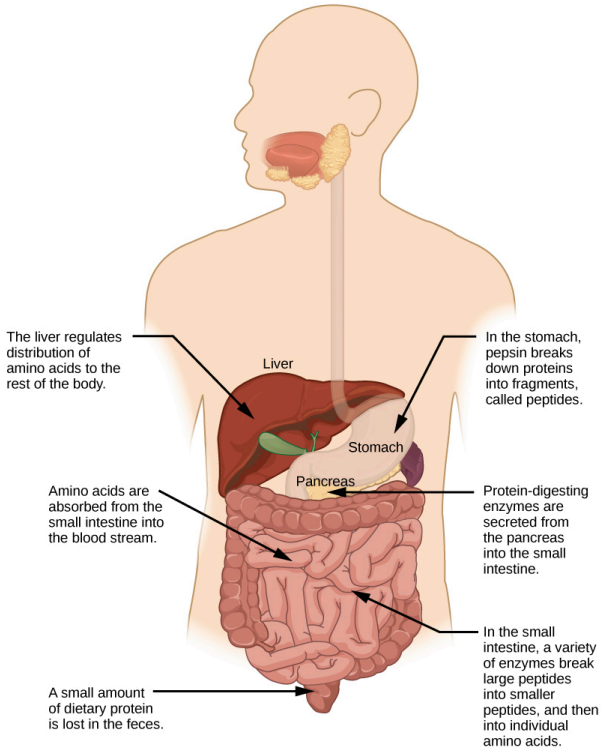


Figure 15.17
Protein digestion is a multistep process that begins in the stomach and continues through the intestines.

https://opentextbc.ca/biology/chapter/15-3 -digestive-system-processes/

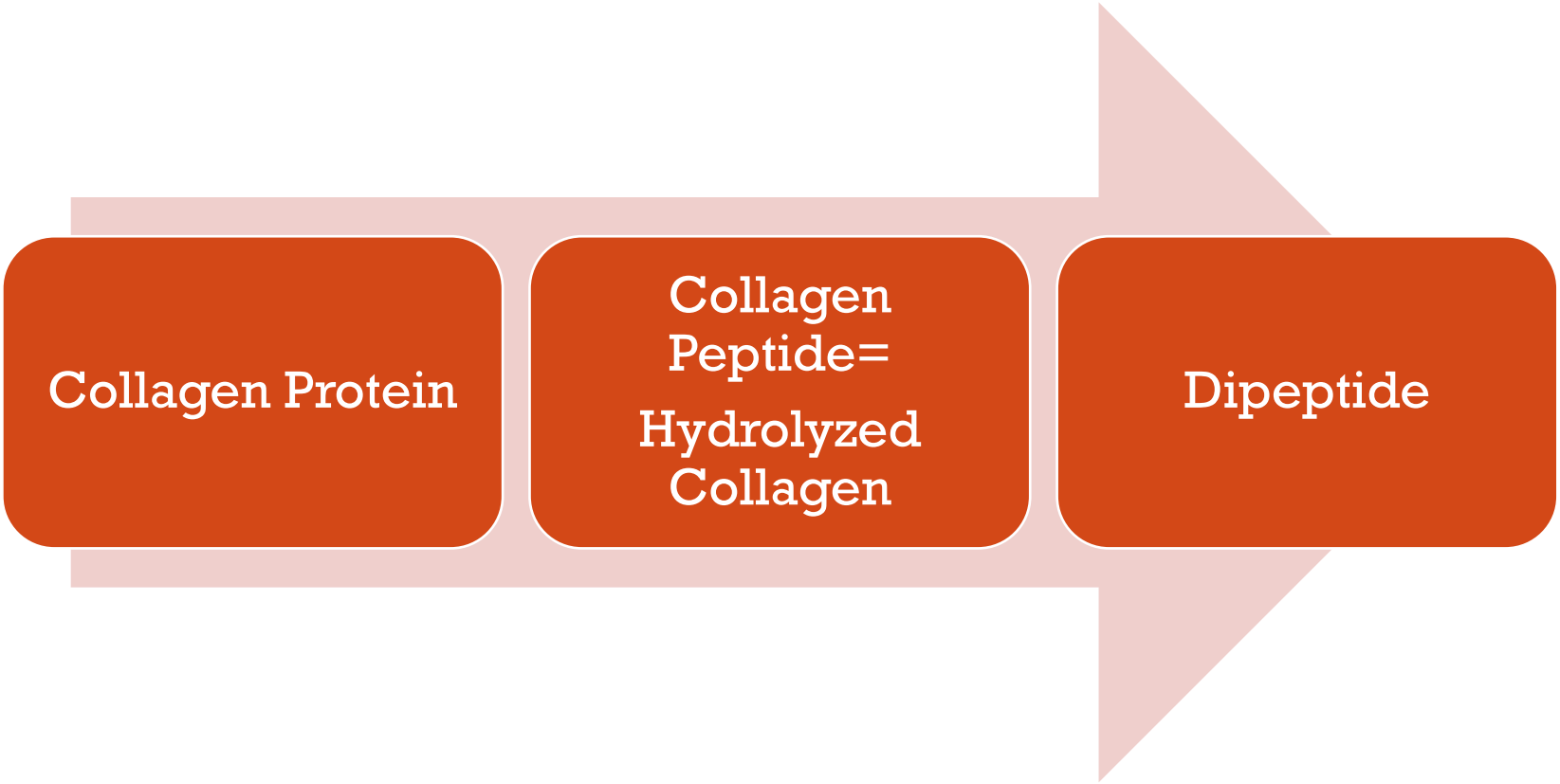
Digestion of Protein

Enzyme	Produced By	Site of Action	Substrate Acting On	End Products
Pepsin	Stomach chief cells	Stomach	Proteins	Peptides
• Trypsin • Elastase Chymotrypsin	Pancreas	Small intestine	Proteins	Peptides
Carboxypeptidase	Pancreas	Small intestine	Peptides	Amino acids and peptides
• Aminopeptidase • Dipeptidase	Lining of intestine	Small intestine	Peptides	Amino acids

Table 15.6.

https://opentextbc.ca/biology/chapter/15-3 -digestive-system-processes/

BIOAVAILABILITY



Research

Double blind, placebo-controlled, randomized trial measured PUSH and PSST Scores wound measurements at 16 weeks were given standard topical care plus one of two types of collagen hydrolysate. This contained prolydroxyproline (PO) and hydroxyprolylglycine (OG). Out of 120 subjects (42 Placebo, 39 low levels and 39 high levels). Scores were significantly lower than placebo group at 16 weeks in both groups containing levels of PO and OG. Study demonstrates that ingestion helps healing of pressure ulcers in addition to standard topical therapy.

Sugihara et. al. Ingestion of bioactive collagen hydrolysates enhanced pressure ulcer healing in a randomized double-blind placebo-controlled clinical study, Scientific Reports 2018 8:11403

Research

Study proposed that oral ingestion of two dipeptides prolyl-hydroxyproline (PO) and hydroxyprolyl-glycine (OG) had reached the skin and improved skin barrier dysfunction. The results demonstrated significant improved skin barrier dysfunction.

Shimizu, Asami et al. Oral collagen-derived dipeptides, prolyl-hydroxyproline and hydroxyprolyl-glycine, ameliorate skin barrier dysfunction and alter gene expression profiles in the skin. BioChemical and Biophysical Research Communications 2014, 456 626-630.

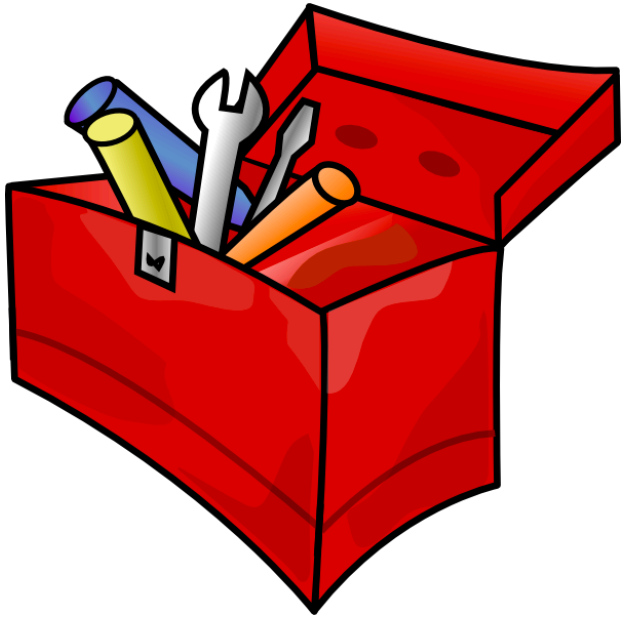
After ingestion of collagen hydrolysate, di- and tri- peptides remained in the blood for a relatively long time. Of these peptides, (PO) has been reported to stimulate cell proliferation and cell growth.

Shgihara, Inoue et al. Quantification of hydroxyprolyl-glycine (PO) in human blood after ingestion of collagen hydrolysate. Journal of Bioscience and Bioengineering 2012 Vol. 113, No. 2:202-203

5 KEY TAKEAWAYS- PROTEIN AND WOUND HEALING

- Adequate protein provision and energy intake are essential for appropriate wound healing
- NPIAP recommend 1.25-1.5g protein/kg body weight and 30-35 kcal/ kg body weight for malnourished patients or those at risk of being malnourished. In addition to Arginine, Zinc and Antioxidant being added to 2019 recommendations.
- Adequate protein stores help control inflammation
- Deficiency can affect all phases of healing
  - Prolonged inflammation
  - ↓ collagen synthesis
- Ongoing research of more bioavailable protein sources promising

What's In Your Wound Care Tool Kit?



Questions?