CLINICAL GUIDELINE

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Treatment of Pressure Ulcers: A Clinical Practice Guideline From the American College of Physicians

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Description: The American College of Physicians (ACP) developed this guideline to present the evidence and provide clinical recommendations based on the comparative effectiveness of treatments of pressure ulcers.

Methods: This guideline is based on published literature on this topic that was identified by using MEDLINE, EMBASE, CINAHL, EBM Reviews, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effects, and the Health Technology Assessment database through February 2014. Searches were limited to English-language publications. The outcomes evaluated for this guideline include complete wound healing, wound size (surface area, volume, and depth) reduction, pain, prevention of sepsis, prevention of osteomyelitis, recurrence rate, and harms of treatment (including but not limited to pain, dermatologic complications, bleeding, and infection). This guideline grades the quality of evidence and strength of recommendations by using ACP's clinical practice guidelines grading system. The target audience for this guideline includes all clinicians, and the target patient population is patients with pressure ulcers.

Recommendation 1: ACP recommends that clinicians use protein or amino acid supplementation in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)

Recommendation 2: ACP recommends that clinicians use hydrocolloid or foam dressings in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)

Recommendation 3: ACP recommends that clinicians use electrical stimulation as adjunctive therapy in patients with pressure ulcers to accelerate wound healing. (Grade: weak recommendation, moderate-quality evidence)

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Pressure ulcers affect 3 million adults in the United States across health care settings. They have a major impact on health status, quality of life, and health care costs. Treatment of pressure ulcers is critical to promote healing and minimize the risk for complications. Treatment interventions include management of conditions that give rise to pressure ulcers (support surfaces and nutritional support), protection and promotion of wound healing (wound dressings; topical applications; and various adjunctive therapies that are used in addition to standard pressure ulcer care, such as vacuum-assisted closure, ultrasound therapy, electrical stimulation, and hyperbaric oxygen therapy), and surgical repair of the wound (1) (Table 1). Treatment of pressure ulcers often requires a multidisciplinary approach involving nurses, physicians, and other members of a care team.

The purpose of this American College of Physicians (ACP) guideline is to present the available evidence on the comparative effectiveness of treatments for pressure ulcers. The target audience for this guideline includes all clinicians, including physicians, nurses, dietitians, and physical therapists. The target patient population comprises adults with pressure ulcers. For recommendations on the risk assessment and prevention of pressure ulcers, please refer to the accompanying ACP guideline (2).

See also:

Related articles . . . . . 359 and Ann Intern Med. 2013;159:39-50
Editorial comment 387
Summary for Patients I-38

Web-Only

Supplement
CME quiz

METHODS

This guideline is based on a systematic evidence review (3), an updated evidence review (**Supplement**, available at www.annals.org), and an evidence report sponsored by the Agency for Healthcare Research and Quality (AHRQ) (1) that addressed the following key questions:

1. In adults with pressure ulcers, what is the comparative effectiveness of treatment strategies for improved health outcomes, including but not limited to complete wound healing, healing time, reduced wound surface area, pain, and prevention of serious complications of infection? Does the comparative effec-

* This paper, written by Amir Qaseem, MD, PhD, MHA; Linda L. Humphrey, MD, MPH; Mary Ann Forciea, MD; Melissa Starkey, PhD; and Thomas D. Denberg, MD, PhD, was developed for the Clinical Guidelines Committee of the American College of Physicians. Individuals who served on the Clinical Guidelines Committee from initiation of the project until its approval were Thomas D. Denberg, MD, PhD (*Chair*); Michael J. Barry, MD; Molly Cooke, MD; Paul Dallas, MD; Nick Fitterman, MD; Mary Ann Forciea, MD; Russell P. Harris, MD, MPH; Linda L. Humphrey, MD, MPH; Tanveer P. Mir, MD; Holger J. Schünemann, MD, PhD; J. Sanford Schwartz, MD; Paul Shekelle, MD, PhD; and Timothy Wilt, MD, MPH. Approved by the ACP Board of Regents on 26 July 2014.

Table 1. Selected Pressure Ulcer Treatment Interventions

Intervention*	Description
Air-fluidized bed†	Redistributes pressure by forcing air through small beads in the mattress, generating a fluid-like surface
Alternating-air bed‡	Changes the distribution of pressure by inflating or deflating cells within the mattress
Low–air-loss bed§	Regulates heat and humidity by flowing air and, sometimes, pressure adjustments
Hydrocolloid dressing	Adheres to the skin and absorbs wound exudates, forming a protective gel around the wound
Radiant heat dressing	Administers heat to the wound site to increase capillary blood flow and promote wound healing
Dextranomer paste	Topical paste used to absorb wound exudates
Oxandrolone	An anabolic steroid that increases protein production and is used to promote healing and weight gain
PDGF	A glycoprotein that has been shown to accelerate wound healing in animal models
Electrical stimulation	Uses surface electrodes to deliver high-voltage electric current through the wound and is believed to promote cell growth and differentiation
Electromagnetic therapy	Delivers an electric and magnetic field to the wound and is believed to promote healing by altering the cell membrane (5)
Therapeutic ultrasound	Application of low-frequency sound waves to damaged tissue; believed to improve wound healing
Negative-pressure wound therapy	Application of negative pressure to the wound site that causes a vacuum and removes exudates while maintaining a moist environment; believed to promote wound healing
Light therapy	Application of energy from the infrared, visible, or ultraviolet spectrum to the wound site to promote healing
Laser therapy	Amplifies light with a high level of spatial and temporal coherence and is believed to improve wound healing

PDGF = platelet-derived growth factor.
* Brand-name products are listed as examples only and should not be considered endorsements from the American College of Physicians.
† Clinitron (Hill-Rom).
‡ Duo 2 (Hill-Rom), Lapidus Airfloat System (American Hospital Supply), MicroPulse, Trinova (Pegasus Healthcare), TriCell and AlphaXcell (ArjoHuntleigh Getinge Group), and Air Doctor.
§ TheraPulse (KCI) and KinAir (ArjoHuntleigh Getinge Group).

tiveness of treatment strategies differ on the basis of features (anatomical site or severity) of the pressure ulcers, patient characteristics, and health care settings?

2. What are the harms of treatments for pressure ulcers? Do the harms differ on the basis of features (anatomical site or severity) of the pressure ulcers, patient characteristics, and health care settings?

We searched MEDLINE, EMBASE, CINAHL, EBM Reviews, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effects, and the Health Technology Assessment database through February 2014 for studies in English. The primary outcomes of interest for this guideline include complete wound healing and wound size (surface area, volume, and depth) reduction. Additional outcomes include pain, prevention of sepsis, prevention of osteomyelitis, recurrence rate, and harms of treatment (including but not limited to pain, dermatologic complications, bleeding, and infection). Although most studies reported statistical significance of various outcomes, the guideline panel assessed clinically significant changes when evaluating the evidence.

Further details about the methods and inclusion and exclusion criteria applied in the evidence review are available in the full AHRQ report (1) and the **Supplement**. This guideline rates the quality of evidence and strength of recommendations by using ACP's guideline grading system (**Table 2**). Details of the ACP guideline development process can be found in ACP's methods paper (4).

BENEFITS AND COMPARATIVE EFFECTIVENESS OF PRESSURE ULCER TREATMENT STRATEGIES

Most studies reported on only 1 outcome each (such as reduction of pressure ulcer size, improved wound healing, or rate of wound healing). Complete wound healing was reported in few studies; intermediate outcomes, such as reduction of wound size and rate of wound healing, were used to assess efficacy of the interventions. Some improvements were seen only in patients with large ulcers (>7 cm). **Table 1** provides descriptions of the various treatment strategies, and **Table 3** summarizes the evidence. Moderate-quality evidence showed that air-fluidized beds reduced pressure ulcer size compared with other surfaces (6–10), but pressure ulcer outcomes did not differ in comparisons of other support surfaces (low- to moderate-quality evidence) (11–14, 21–25). Moderate-quality evidence showed that protein-containing supplements improved wound healing (27–40), although vitamin C supplementation did not (low-quality evidence) (26). Low-quality evidence showed that hydrocolloid dressings reduced ulcer size compared with gauze dressings (42–51) and that platelet-derived growth factor (PDGF) improved wound healing (69–73). Findings were mixed or did not differ for hydrocolloid compared with foam dressings (moderate-quality evidence) (52–59), radiant heat (moderate-quality evidence) (60–63), topical collagen (low-quality evidence) (42, 66–68), and oxandrolone (41). Low-quality evidence showed that dextranomer paste was inferior to other wound dressings for

Table 2. The American College of Physicians' Guideline Grading System*

Quality of Evidence	Strength of Recommendation	
	Benefits Clearly Outweigh Risks and Burden or Risks and Burden Clearly Outweigh Benefits	Benefits Finely Balanced With Risks and Burden
High	Strong	Weak
Moderate	Strong	Weak
Low	Strong	Weak
Insufficient evidence to determine net benefits or risks		

* Adopted from the classification developed by the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) workgroup.

Table 3. Evidence for Pressure Ulcer Treatment Strategies

Intervention	Quality of Evidence	Overall Treatment Effect vs. Comparator*	Data
Support surfaces			
Air-fluidized beds vs. other surfaces	Moderate	Improved	Air-fluidized beds reduced pressure ulcer size compared with other surfaces; 1 good-quality, 3 fair-quality, and 1 poor-quality studies (6–10)
Alternating-air beds vs. other surfaces	Low	No difference	Similar efficacy in pressure ulcer size reduction compared with other surfaces; 2 fair-quality and 2 poor-quality studies (11–14)
Different brands of alternating-air beds	Moderate	No difference	Similar efficacy in complete wound healing and wound size reduction among different brands; 2 good-quality and 2 fair-quality studies (15–20)
Low-air-loss beds vs. other surfaces	Low	No difference	Similar efficacy in wound size reduction; 1 good-quality and 4 poor-quality studies (21–25)
Nutrition			
Vitamin C supplementation	Low	No difference	No improvement in rate of pressure ulcer healing; 1 good-quality study (26)
Protein supplementation	Moderate	Improved	Protein supplementation improved wound healing (most often reported as decreased ulcer size); 2 good-quality, 5 fair-quality, and 7 poor-quality studies (27–40)
Medications			
Oxandrolone vs. placebo	Low	No difference	No difference for complete wound healing (24% vs. 30%) or percentage of ulcers remaining healed at 8-wk follow-up (17% vs. 15%); more patients had elevated liver enzyme levels (32.4% vs. 2.9%; P <0.001); 1 good-quality study (41)
Local wound applications			
Hydrocolloid dressings vs. usual care	Low	Improved	Hydrocolloid dressings resulted in reduced wound size compared with usual care; 1 good-quality, 2 fair-quality, and 7 poor-quality studies (42–51)
Hydrocolloid dressings vs. foam dressings	Moderate	No difference	Similar efficacy in complete wound healing: RR, 1.12 (95% CI, 0.88 to 1.41); 3 fair-quality and 5 poor-quality studies (52–59)
Radiant heat dressings vs. other dressings	Moderate	Mixed results	Radiant heat dressings resulted in a faster wound healing rate and similar complete wound healing (RR, 1.32 [CI, 0.88 to 1.98]) compared with other dressings; 2 good-quality and 2 fair-quality studies (60–63)
Dextranomer paste vs. wound dressings	Low	Worsened	Dextranomer paste was inferior to other dressings for reducing wound area; 1 good-quality and 1 poor-quality study (64, 65)
Topical collagen vs. hydrocolloid dressings or usual care	Low	No difference	Similar efficacy in reducing wound size compared with other dressings; 1 good-quality, 1 fair-quality, and 2 poor-quality studies (42, 66–68)
PDGF vs. placebo	Low	Improved	PDGF improved wound healing compared with placebo; 1 fair-quality and 3 poor-quality studies (69–73)
Adjunctive therapies			
Electrical stimulation vs. sham treatment	Moderate	Improved	Electrical stimulation accelerated wound healing compared with sham treatment, but no evidence was found for improved complete wound healing; adverse events were more common in elderly patients than younger patients; 1 good-quality and 8 fair-quality studies (74–83)
Electromagnetic therapy vs. sham treatment	Low	No difference	Similar efficacy in reducing wound size for stage 2 to 4 pressure ulcers compared with sham treatment; 4 fair-quality studies (84–87)
Therapeutic ultrasound vs. sham treatment	Low	No difference	Similar efficacy in complete wound healing or healing rate compared with sham treatment; 2 good-quality and 1 fair-quality studies (88–90)
Negative-pressure wound therapy vs. usual care	Low	No difference	Similar efficacy in reducing wound size compared with standard care; 3 fair-quality studies (91–93)
Light therapy vs. sham treatment or usual care	Low	Mixed results	Light therapy reduced ulcer surface area compared with sham treatment or usual care but showed no improvement in complete wound healing; 6 fair-quality studies (94–99)
Laser therapy vs. sham treatment	Low	No difference	Similar efficacy in reducing wound size compared with sham treatment; 1 good-quality and 3 fair-quality studies (100–103)

PDGF = platelet-derived growth factor; RR = relative risk.
* "Improved" denotes that the intervention provided benefit compared with control. "Worsened" indicates that the intervention was worse than control. "No difference" indicates that the intervention was similar to control. "Mixed results" denotes inconsistent results for different outcomes.

reducing ulcer area (64, 65). Moderate-quality evidence showed that electrical stimulation accelerated wound healing as an adjunctive therapy (74–83), and low-quality evidence showed no difference or mixed findings for the other adjunctive therapies assessed, including electromagnetic therapy (84–87), therapeutic ultrasound (88–90), negative-pressure wound therapy (91–93), light therapy (94–96), and laser therapy (100–103).

Effectiveness of Pressure Ulcer Treatment Strategies Based on Pressure Ulcer Features, Patient Characteristics, and Health Care Settings

Low-quality evidence from 3 fair-quality retrospective studies showed that patients with sacral pressure ulcers had a lower recurrence rate after surgery than those with ischial pressure ulcers (104–106).

Low-quality evidence from 1 fair-quality study showed that patients with spinal cord injury had a higher rate of recurrent pressure ulcers after surgical flap closure than other patients with pressure ulcers (104).

Low-quality evidence from 1 good-quality and 3 fair-quality studies showed that electrical stimulation was similarly effective in patients with spinal cord injuries compared with other patients (74, 78, 80, 81).

Low-quality evidence from 1 good-quality and 8 fair-quality studies showed that electrical stimulation produced similar results in a hospital and a rehabilitation center (74–83).

Harms of Pressure Ulcer Treatment Strategies

Reporting of harms was sparse, and comparison among trials was difficult because of heterogeneity of treatments or populations.

Support Surfaces

Evidence was insufficient to conclude about harms for various support surfaces because few studies reported adverse events and those that reported them mostly found no statistically significant difference compared with controls.

Nutrition

Evidence was insufficient to conclude about harms for nutritional supplementation because adverse event reporting was poor for these studies.

Medications

More patients had elevated liver enzyme levels (32.4% vs. 2.9%; $P < 0.001$) with oxandrolone than with placebo, but there was no difference in withdrawals due to adverse events (19% vs. 18%) (41).

Local Wound Applications

Skin irritation, inflammation, and tissue damage and maceration were the most commonly reported harms for various dressings and topical therapies (moderate-quality evidence). Evidence was insufficient to determine whether specific dressings or topical therapies resulted in less harm than others. Evidence was also insufficient to conclude about harms for biological agents because few harms were reported and the studies lacked precision.

Surgery

The most commonly reported harm from surgery was dehiscence. Reoperation due to recurrence or flap (tissue placed over the open wound) failure ranged from 12% to 24% among patients treated with surgery (low-quality evidence) (105, 107). Low-quality evidence from 1 intervention series showed a 21% complication rate for all skin flap surgeries and showed that tensor fascia lata flaps were associated with higher complication rates (49%), whereas rotation flaps were associated with the lowest complication rates (12%) compared with other surgical flap procedures (108).

Adjunctive Therapies

The most common adverse effect reported with electrical stimulation was skin irritation (low-quality evidence) (75, 79, 81). No substantial adverse effects were reported for light therapy (94, 95, 97, 98) or laser therapy (100–103) (low-quality evidence).

Harms of Pressure Ulcer Treatments Based on Pressure Ulcer Features, Patient Characteristics, and Health Care Settings

Dehiscence was more common if bone was removed during the surgery (low-quality evidence) (105), and patients with ischial ulcers had higher complication rates than those with sacral or trochanteric ulcers (low-quality evidence) (107, 109).

Low-quality evidence showed that frail elderly patients had more adverse events associated with electrical stimulation than younger patients (75, 79, 81).

Summary

Treatment of pressure ulcers involves multiple methods intended to alleviate the conditions contributing to ulcer development (support surfaces, repositioning, and nutritional support), protection of the wound from contamination and creation of a clean wound environment, promotion of tissue healing (local wound applications, debridement, and wound cleansing), adjunctive therapies, and consideration for surgical repair. Evidence showed that many interventions were similar to controls for alleviation of pressure ulcers. Air-fluidized beds were superior to other support surfaces (primarily standard hospital beds) for reducing pressure ulcer size. Alternating-air beds and low–air-loss mattresses did not differ substantially from other surfaces for reducing wound size. Overall, few harms were reported for support surfaces.

Nutritional supplementation with protein or amino acids improved the rate of wound healing.

Hydrocolloid dressings were superior to gauze dressings for reducing wound size and were equivalent to foam dressings for complete wound healing. Although radiant heat dressings accelerated wound healing, there was no evidence that they improved complete wound healing compared with other dressings. Dextranomer paste was inferior to other dressings for reducing wound size. Platelet-derived growth factor improved ulcer healing compared with placebo for more severe ulcers, and evidence was insufficient to determine the effect of other biological agents. The most commonly reported harms for local wound applications included skin irritation, inflammation, and tissue damage and maceration.

Adjunctive therapies, including electromagnetic therapy, negative-pressure wound therapy, therapeutic ultrasound, and laser therapy, were similar to controls for ulcer alleviation. Electrical stimulation accelerated wound healing compared with control, but there was

Figure. Summary of the American College of Physicians guideline on treatment of pressure ulcers.

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SUMMARY OF THE AMERICAN COLLEGE OF PHYSICIANS GUIDELINE ON TREATMENT OF PRESSURE ULCERS

Disease/Condition	Pressure ulcers
Target Audience	Internists, family physicians, and other clinicians
Target Patient Population	Patients with pressure ulcers
Interventions Evaluated	Support surfaces: air-fluidized beds, alternating-air beds, low–air-loss beds, alternating-air chair cushions Nutrition: protein or amino acid supplementation, vitamin C supplementation, zinc supplementation Medication: oxandrolone Local wound applications: hydrocolloid dressings, foam dressings, debriding enzymes, radiant heat dressings, dextranomer paste, topical collagen, PDGF, topical phenytoin, maggot therapy, other biological agents (fibroblast, nerve, and macrophage suspension) Surgery Adjunctive therapies: electrical stimulation, electromagnetic therapy, therapeutic ultrasound, negative-pressure wound therapy, light therapy, laser therapy, hydrotherapy
Outcomes Evaluated	Effectiveness of wound healing: Wound improvement: determined by complete wound healing, healing rate or time, reduction in wound size (surface area, volume, depth) Reduction in pain Prevention of serious complications (sepsis or osteomyelitis) Recurrence rate Harms: Pain Dermatologic complications Bleeding Infection
Benefits	Support surfaces Air-fluidized beds: reduced pressure ulcer size Nutrition Protein or amino acid supplementation: improved wound healing (most often reported as decreased ulcer size) Local wound applications Hydrocolloid dressings: improved wound healing Radiant heat dressings: resulted in faster wound healing rate PDGF: improved wound healing Adjunctive therapies Electrical stimulation: accelerated wound healing Light therapy: reduced ulcer surface area
Harms	Local wound applications Dressings and topical therapies: skin irritation, inflammation, and tissue damage and maceration Medication: elevated liver enzyme levels associated with oxandrolone Adjunctive therapies Electrical stimulation: skin irritation Surgery: dehiscence, reoperation due to recurrence, or surgical flap failure Limited evidence or no harms reported for other interventions
Recommendations	*Recommendation 1: ACP recommends that clinicians use protein or amino acid supplementation in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)* *Recommendation 2: ACP recommends that clinicians use hydrocolloid or foam dressings in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)* *Recommendation 3: ACP recommends that clinicians use electrical stimulation as adjunctive therapy in patients with pressure ulcers to accelerate wound healing. (Grade: weak recommendation, moderate-quality evidence)*
Inconclusive Areas of Evidence	Evidence was insufficient to determine the effectiveness or comparative effectiveness of alternating-air chair cushions, 3-dimensional polyester overlay vs. gel overlay, zinc supplementation, L-carnosine supplementation, comparisons of wound dressings other than those addressed above, debriding enzymes compared with dressings or other topical therapies, topical application of phenytoin to promote healing, maggot therapy, biological agents other than PDGF (fibroblast, nerve, and macrophage suspension), surgical techniques, or hydrotherapy (wound cleansing with whirlpool or pulsed lavage) for treatment of pressure ulcers.
High-Value Care	ACP does not recommend the use of various advanced support surfaces, including alternating-air and low–air-loss beds, because the quality of evidence for these surfaces was limited and the harms from these types of beds were poorly reported and could be significant given the immobility of the patient. Furthermore, the use of advanced support surfaces adds unnecessary costs to health care systems. In addition, although low-quality evidence suggests that dressings containing PDGF promote healing, ACP supports the use of other dressings, such as hydrocolloid and foam dressings, which are effective at promoting healing and cost less than PDGF dressings.
Clinical Considerations	Assessment and staging of pressure ulcers is the first step before starting treatment. The most commonly used staging system is from the National Pressure Ulcer Advisory Panel (110). Patient progress should be monitored on a regular basis, including the status of the dressing, the area surrounding the ulcer, pain, and possible infection. Frail elderly patients may be more susceptible to adverse effects from electrical stimulation.

PDGF = platelet-derived growth factor.

no evidence that it was superior for complete wound healing. The most common adverse effect for this treatment was skin irritation, and frail elderly patients were more susceptible to adverse events associated with electrical stimulation. Light therapy resulted in reduced ulcer size compared with control and was not associated with any substantial adverse events; however, it was equivalent to sham treatment for complete wound healing.

Although surgery is considered an option for advanced-stage pressure ulcers, evidence was insufficient to determine the superiority of one surgical technique over another for wound closure. Dehiscence, a commonly reported adverse event, was more common when bone was removed and in patients with ischial ulcers.

RECOMMENDATIONS

Recommendation 1: ACP recommends that clinicians use protein or amino acid supplementation in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)

Evidence showed that nutritional supplementation with protein or amino acids reduced pressure ulcer wound size, but evidence for the optimal dose or form of protein was insufficient. Protein supplementation was assessed in conjunction with standard therapies, such as dressings or support surfaces. Also, the trials generally included patients with nutritional deficiencies, and the evidence may not be generalizable to all patients with pressure ulcers because they may not benefit from nutritional supplementation. Evidence also did not show any benefit of vitamin C supplementation compared with placebo. Data are insufficient to comment on complete wound healing. The relationship between reduction in wound size or rate of healing and eventual complete healing has not been well-defined.

Recommendation 2: ACP recommends that clinicians use hydrocolloid or foam dressings in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)

Low-quality evidence showed that hydrocolloid dressings are better than gauze dressings for reducing wound size. In addition, moderate-quality evidence showed that hydrocolloid dressings resulted in complete wound healing similar to that of foam dressings (hydrocellular or polyurethane). Evidence was insufficient to determine whether specific dressings resulted in fewer harms than others. Data are insufficient to comment on complete wound healing. The relationship between reduction in wound size or rate of healing and eventual complete healing has not been well-defined.

Recommendation 3: ACP recommends that clinicians use electrical stimulation as adjunctive therapy in patients with pressure ulcers to accelerate wound healing. (Grade: weak recommendation, moderate-quality evidence)

Moderate-quality evidence supports the use of electrical stimulation in addition to standard treatment because it has been shown to accelerate the healing rate of stage 2 to 4 ulcers. Data are insufficient to comment on complete wound healing. The relationship between reduction in wound size or rate of healing and eventual complete healing has not been well-defined.

The **Figure** summarizes the recommendations and clinical considerations.

INCONCLUSIVE AREAS OF EVIDENCE

Evidence was insufficient to determine the effectiveness or comparative effectiveness of alternating-air chair cushions, 3-dimensional polyester overlays versus gel overlays, zinc supplementation, L-carnosine supplementation, comparisons of different wound dressings other than those addressed earlier, debriding enzymes compared with dressings or other topical therapies, topical application of phenytoin to promote healing, maggot therapy, biological agents other than PDGF (fibroblast, nerve, and macrophage suspension), surgical techniques, or hydrotherapy (wound cleansing using whirlpool or pulsed lavage) for treatment of pressure ulcers (1) (**Supplement**). Evidence was also insufficient to balance the benefits and harms of various support surfaces to treat pressure ulcers. Many studies assessed reduction in wound size or rate of healing rather than complete wound healing, and more evidence is needed on intermediate outcomes as predictors of complete healing, the most important outcome. Although hyperbaric oxygen therapy is often used to treat pressure ulcers in hospitals, we found insufficient evidence to assess its safety and efficacy.

HIGH-VALUE CARE

ACP does not recommend the use of various advanced support surfaces, including alternating-air and low–air-loss beds, because the quality of evidence for these surfaces was limited and the harms were poorly reported and could be significant given the immobility of the patient. Furthermore, due to their expense, the use of advanced support surfaces adds unnecessary costs to health care systems. In addition, although low-quality evidence showed that dressings containing PDGF promoted healing, ACP supports the use of other dressings, such as hydrocolloid and foam dressings, which are effective at promoting healing and cost less than PDGF dressings.

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