Acute Physical Therapy Management of Skin Grafts and Flaps

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Learning Objectives
• Explain the procedure for skin grafting and stages of healing.
• Evaluate the evidence regarding mobilization after skin grafting.
• Differentiate the types of tissue flaps and understand the physiological response to these procedures.
• Employ proper monitoring techniques when mobilizing patients following flap reconstruction.
• Apply evidence-based knowledge to make recommendations regarding appropriate activity progression.

Evidence is changing culture...

Disclosures
The presenters have no conflicts of interest.

Course Outline
• Skin Grafts
  • Types of Grafts
  • Phases of healing
  • Reasons for failure
  • Identification of healthy and non-healing grafts using photos
  • Post-operative care
    • Traditional
    • Review of evidence
  • Proposed practice guidelines
  • Use of negative pressure wound therapy
• Flaps
  • Types of flaps
  • Post-operative care
  • Clinical signs of a failing flap
  • Methods for monitoring
  • Review of evidence related to mobilization
  • Clinical application with case scenarios and discussion
• Areas that need further research

Vision Statement:
"Acute care physical therapy is provided by physical therapists who:
• As integral members of the health care team, are consulted for their expertise in patient management and clinical decision making for patients with acute health care needs.
• May be board-certified specialists in acute care physical therapy.
• May be assisted, in a team relationship, by physical therapist assistants, who may be recognized for advanced proficiency.

The Acute Care Section of the American Physical Therapy Association is recognized as the expert resource for the provision of evidence-based acute care physical therapy."

http://www.acutept.org
How do we know...

• When a patient should get up?
• If he/she should walk? Weight bear? Wear compression?
• What the appropriate level and type of activity is?

... and who decides?

Types of Grafts

<table>
<thead>
<tr>
<th>Graft</th>
<th>Description</th>
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<tbody>
<tr>
<td>Autograft</td>
<td>Patient's own skin taken</td>
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<tr>
<td>Split-thickness skin graft</td>
<td>Autograft consisting of epidermis and a portion of the dermis</td>
</tr>
<tr>
<td>Full-thickness skin graft</td>
<td>Autograft consisting of epidermis and the entire dermis</td>
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<tr>
<td>Mesh graft</td>
<td>Autograft placed through a mesher to provide more surface area</td>
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<tr>
<td>Sheet graft</td>
<td>Autograft without meshing</td>
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<tr>
<td>Allograft</td>
<td>Graft from same species</td>
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<tr>
<td>Xenograft</td>
<td>Temporary graft of porcine skin</td>
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<tr>
<td>Cultured epidermal autograft (CEA)</td>
<td>Autograft of unburned epithelial cells cultured in the lab</td>
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Skin Graft

• Consists of epidermis and dermis
  • Split thickness: varying amounts of dermis
  • Full thickness: contains entire dermis
• Is devascularized and requires re-vascularization from site where it is placed
• Number of epithelial appendages depends on the thickness of the graft

Phases of Skin Graft Healing

1. Imbition
   • Graft survives by diffusion of nutrients from the wound bed
   • Fibrin deposition
2. Neovascularization
   • New vessels invade the graft by angiogenesis
3. Maturation
   • New collagen bridges form between the wound bed and graft

Why Grafts Fail...

• Formation of hematoma or seroma
• Infection
• Incomplete excision of nonviable tissue
• Shearing or trauma to the graft site
When to mobilize?
The question of WHEN to safely mobilize after skin grafting has been asked for MANY years...

There have been studies reaching back to the 1970s which indicate that early ambulation (within 24-48 hours post op) of patients with lower extremity skin grafts may be safe

• "The early ambulation of patients with lower limb grafts" (Bodenham & Watson 1971)
• "A technic of lower extremity mesh grafting with early ambulation" (Golden, Power, & Skinner, et al 1977)
• "The immediate mobilisation of patients with lower limb skin grafts: a clinical report." (Shaply, Cardoso & Bakhet 1983)

However more robust evidence is limited, and conservative post operative protocols of bedrest and delayed mobilization remain in place throughout the county

What the evidence says...

"Immediate Ambulation of Patients with Lower Extremity Grafts"

• Retrospective study
• Splints used if the graft crossed a joint
• Patients encouraged to walk once recovered from the anesthetic
• Average skin graft take: 96.4%
• Average time until able to ambulate 30 feet independently: 1.7 days


More evidence...

"Effect of early and late mobilisation on split skin graft outcome"

• Retrospective study of various populations requiring lower extremity grafts
• Patients stratified into two groups:
  - Early mobilisation (0-3 days bedrest) & Late mobilisation (≥ 4 days bedrest)
• No significant difference in the healing rate:
  - EM had 88% healing rate
  - LM had 91% healing rate
• No significant difference in rates of graft loss, infection, herniations, hypergranulation
  • Significantly higher rate of deconditioning in LM group
  • Significantly different post-op length of stay:
    - EM 5.20 days
    - LM 7.96 days


Conclusions

"The consistent finding in the literature is that early ambulation can be safely initiated after lower extremity skin grafting without compromising graft take if external compression is applied"

"No studies of any patient population have concluded that early ambulation compromises graft take"


Traditional Post-operative Care

• Immobilization for 5 days
• Bedrest
• No ROM of joints which new graft crosses
• Bolster dressing that is removed on POD 3-5
• Resume ROM and mobility on POD 5

Proposed Practice Guidelines

• "An early postoperative ambulation protocol should be initiated immediately, or as soon as possible, after lower extremity grafting unless any exclusion criteria are encountered."
• "External compression must be applied before ambulation."
• "If the graft crosses a joint, the joint should be immobilized continuously until the first dressing change."

Evidence

"Retrospective evaluation of clinical outcomes in subjects with split-thickness skin graft: comparing V.A.C. therapy and conventional therapy..."

- Retrospective review of 142 patients who underwent LE STSG; either conventional dressings (CT) or V.A.C. therapy (NPWT) used post-operatively
- Significantly greater percentage of graft take at first follow-up, maximal graft take, and graft acceptance for the NPWT group
  - 96 ± 3%, 96 ± 3%, 97% for NPWT respectively
  - 94 ± 3%, 93 ± 3%, 94% for CT respectively
- Significantly fewer repeated STSGs required for the NPWT group
  - 3.5% for NPWT
  - 10% for CT

More Evidence...

"Effectiveness of Negative Pressure Closure in the Integration of Split Thickness Skin Grafts"

- Randomized controlled trial of 60 patients requiring STSG after burn injury; randomized into two groups: Negative pressure closure, Control group
- Significantly less graft loss (median) in the NPC group:
  - 0.0 cm², 0.1% in NPC group
  - 4.5 cm², 12.8% in the control group
- Significantly shorter length of hospital stay (median) in the NPC group:
  - 13.5 days in NPC group
  - 17 days in control group

Clinical Take-Aways for Skin Grafts

- Shearing of the skin graft should be avoided
  - No KISS if a graft crosses a joint until POD 5
- Edema puts a graft at risk poor adherence
  - Devise exercise at rest
  - Use ice compression
- Evidence supports early ambulation with skin grafting
- Use of a wound VAC over a graft helps prevent shearing and promotes adherence of the skin graft
  - Facilitates mobility
  - Splinting should still be considered
- Collaborate with surgical team to advocate for a mobility plan with which all parties agree

Flaps

A flap is a unit of skin, underlying tissue, and blood supply transferred from a donor to a recipient site.

Can be classified by:

- Component parts
  - Fasciocutaneous
  - Musculocutaneous
  - Osseocutaneous
- Nature of the blood supply
  - Random
  - Arterial
- The movement placed on the flap
  - Advancement
  - Pivot
  - Transposition
- Relationship to the defect
  - Local
  - Regional
  - Distant
Distant Flaps

Can be transferred over a great distance as a pedicled flap or free flap

- **Pedicled flap:** vascular supply remains anatomically connected
- **Free flaps:** vascular supply is disconnected and microsurgically reconnected to a new artery and new vein near the recipient site

Gastrocnemius Muscle Flap

Post-operative Care

- Maintaining arterial inflow and venous outflow is imperative
- Venous insufficiency is more common than arterial
- Majority of compromise occurs within the first 72 hours after surgery
- May require emergent exploration to restore circulation
- Close monitoring is essential

### Clinical Signs of a Failing Flap

<table>
<thead>
<tr>
<th>Signs of arterial insufficiency</th>
<th>Signs of venous insufficiency</th>
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<tbody>
<tr>
<td>• Pale or mottled flap color</td>
<td>• Purplish blue or dusky</td>
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<tr>
<td></td>
<td>discoloration</td>
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<tr>
<td>• Reduction in flap temperature</td>
<td>• Congestion</td>
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<tr>
<td>• Loss of capillary refill (&gt;2 sec)</td>
<td>• Swelling</td>
</tr>
<tr>
<td>• Loss of flap turgor</td>
<td>• Rapid capillary refill,</td>
</tr>
<tr>
<td></td>
<td>followed by eventual loss of capillary refill</td>
</tr>
<tr>
<td></td>
<td>• Dark bleeding at the edges</td>
</tr>
<tr>
<td></td>
<td>• Eventual loss of arterial inflow</td>
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### Methods for Monitoring the Flap

- Clinical observation
- Pinprick testing
- Surface temperature monitoring
- Hand-held Doppler ultrasonography
- Implantable Doppler
- Pulse oximetry
- Laser Doppler
- Tissue pH
- Photography

### Hand-held Doppler Probe

- Most common method of monitoring
- Must be sure to detect the flap’s vascular pedicle rather than the recipient vessel.
Viopix Monitoring

- Noninvasive
- Measures the scattering and absorption of near-infrared light
- The ratio of oxyhemoglobin and deoxyhemoglobin provides real time measurement of the tissue’s oxygenation.
- Sensitivity is also displayed


Blood Supply

- Macrocirculation
- Microcirculation
- Arterial inflow supplies nutrients and oxygen to tissue
- Venous outflow removes carbon dioxide and waste
- Systemic regulation of blood flow is mediated by:
  - Neural receptors
  - α-adrenergic, β-adrenergic, serotonergic
  - Humoral substances
  - Norepinephrine, epinephrine, serotonin, histamine, prostaglandins

Blood Flow with Elevation

- With elevation, sympathetic nerves and inflow vessels are divided.
- Blood flow is only 20% of normal in the distal end of a pedicled flap within 6-12 hours.
- In 1-2 weeks, 75% of normal flow is recovered.
- In 3-4 weeks, flow returns to 100%.
- Neovascularization can sustain a flap from days 3-10 post-operatively, even after arterial occlusion

RecommendaFons for PostoperaFve Care by Rohde, et al

- Any personnel with specific training may start dangling
- Start dangling protocol at POD 14
- Start dangling for 5 minutes twice daily; increase by 5 minutes per session per day or add an additional session
Recommendations, continued

Two approaches for compression are proposed:

- The extremity should be wrapped with each dangling
  OR
- Compressive wrap should not be placed until the wound is mature and the patient is tolerating dangling

Recommendations, continued

- Assess flap before and after dangling/wrapping
- Weight bearing
  - Per orthopedics if there is a fracture
  - If no fracture, begin weight bearing when wound is mature and patient tolerates dangling 30 minutes 6 times per day
- Discharge patient when patient tolerates dangling with a good understanding of flap assessment (2-3 weeks)

Tissue Oxygenation with Free Flap Dangling

A “Dangle Protocol”

Surgeon-specific and patient-specific:

- Usually begins “post-op day 7”
- Usually allowed 5 minutes, three times daily
- Compression depends on the surgeon
- Flap should be assessed before, during and after:
  - Color (pale, mottled, bluish, cyanotic, dusky)
  - Swelling
  - Temperature
  - Doppler

Clinical Take-Aways for Flaps

- Familiarize yourself with the surgical procedure and what structures were involved.
- Consider the implication of activity on the viability of the flap and advocate for the appropriate progression.
- Be sure to monitor the flap, communicate with the team, and document!
- Weightbearing is usually less of an issue than limb dependency is.
- Avoid exercise or activity that will shunt blood away from the flap for prolonged periods.

Case Scenario 1

52 year old female sustained deep partial thickness burn to R anterior lower leg, dorsum of foot and toes while lighting a wood burning stove

- Burn is < 5% TBSA
- No inhalation injury
- Underwent multiple surgeries for debriement of LE
- Ultimately underwent meshed STSG to the anterior lower leg and dorsum of foot
### Case Scenario 1

- What needs to be considered in this case prior to initiating mobilization?
- When would it be appropriate for her to mobilize?
- What kind of weight bearing would be appropriate?

### Case Scenario 2

48 year old s/p fall from a ladder in which he sustained a comminuted distal tib/ fib fracture.
- Hospital day 1: To OR for I&D, wound vac placement, and external fixation on day of injury.
- Hospital day 3: Repeat I&D; vac change
- Hospital day 4: PT evaluation

What precautions would you anticipate?
What would his initial mobility goals include?

### Case 2, continued

- Hospital day 7: Returned to OR for I&D, removal of ex fix, ORIF, anterolateral thigh free flap to left ankle
- Hospital day 8: Returned to OR for failing free flap. Underwent redo of the arterial anastomosis and venous outflow reestablished with bypass using contralateral saphenous vein.
- Hospital day 14: Returned to OR for re-inset of flap and STSG.
- Hospital day 19: PT reevaluation

What precautions would you anticipate?
How should his physical therapy goals be updated?

### Case 2, continued

- Actual post-operative instructions:
  - NWB LLE
  - Dangle x5 minutes, three times daily
  - Ace wrap lower leg and foot prior to dangle and remove after
  - Monitor cough signal, foot color, DP, PT pulse with dangle
  - Goals
  - Progression of dangling
  - Considerations for discharge planning

### Case Scenario 3

63 year old male with history of craniotomy for oligodendroglioma in 1999.
- Developed infection and exposed hardware and underwent multiple surgeries, followed by management with a wound vac.
- Underwent cranioplasty with removal of infected titanium mesh and reconstruction with new titanium mesh, screws, and coverage with a free latissimus dorsi flap and split thickness skin graft.
- Hospital day 2: PT consult
- Dark red bloody drainage noted with mobilization

What precautions should be followed?
Special considerations for monitoring?

### Case 3, continued

- Hospital day 4: Returned to OR for debridement for failed latissimus dorsi muscle flap/ I&D, free rectus myocutaneous microvascular free flap and STSG.
- Hospital day 10: PT re-consulted
- Purulent drainage noted with mobilization
- Returned to OR for removal of mesh cranioplasty from R parietal region, I&D, Vac placement
- Hospital day 12: Returned to OR for vac change, debridement of muscle flap, and closure of anterior scalp wound.
Areas for Further Research...

- Use of assistive device after grafting
- Mobilization with the use of a wound VAC grafts
- Early vs. late compression after flap
- Optimal type and amount of compression
- When to begin dangling after flap
- Optimal progression of time limb is dependent
- Impact of cardiovascular exercise on flap survival

Questions and comments....

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References