VOLUME 1: ISSUE 1

APTA

Journal of Clinical Electrophysiology & Wound Management

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Editorial Board

Editorial

Letter from the Editor-in-Chief

I am thrilled to welcome you to the first issue of Journal of Clinical Electrophysiology and Wound Management. With the help of our outstanding editorial team, I am honored to lead this project dedicated to advancing the knowledge and clinical practice in electrodiagnostics, wound management, biophysical agents, and neuromusculoskeletal ultrasound. The Journal of Clinical Electrophysiology and Wound Management publishes peer reviewed articles and disseminates research and clinical evidence pertaining to these areas.

There are four specialized areas of practice and two ABPTS board certifications under the Academy of Clinical Electrophysiology and Wound Management within the American Physical Therapy Association. By providing a platform for publishing research and clinical evidence in these specialty areas, JCEWM will provide value to its members and the profession for years to come.

In the establishment of this journal, the JCEWM editorial board would like to thank the ACEWM board for its support. We also express our gratitude to our reviewers for their time, expertise, insightful comments, and suggestions that greatly added to the quality of these publications.

Let us embrace the challenges and the opportunities to make a positive impact on the lives of those we serve. We invite you to submit your papers to JCEWM.

I hope you enjoy reading this inaugural issue of JCEWM.

Mohini Rawat PT, DPT, ECS, OCS, RMSK

Editor-in-Chief – Journal of Clinical Electrophysiology & Wound Management.

Editorial

Letter from the Academy President

Greetings! And welcome to the inaugural issue of the "Journal of Clinical Electrophysiology & Wound Management." We are very proud to be highlighting physical therapy practice in the areas of electrodiagnostics, wound management, biophysical agents and neuromusculoskeletal ultrasonography. The Academy of Clinical Electrophysiology & Wound Management has discussed the possibility of a Journal for years, but as you can imagine, bringing something like this to fruition is no small feat. I want to sincerely thank our Editor in Chief – Mohini Rawat, as well as our Associate Editors, for their hard work and tireless efforts in making this Journal a reality. I would also like to thank the Academy's Immediate Past-President – Karen Gibbs – for her support of this project during her tenure. For all of you that submitted articles for the Journal – you're awesome! Moving best practice forward requires clinicians, researchers and educators willing to share their expertise. I encourage everyone reading this Journal to consider contributing to future issues. We all have knowledge to share, and who knows how many patients or clinicians might benefit from your experience? I am excited to be offering a Journal of this quality as a member benefit for our Academy and I hope that it helps you in your practice. While our specialty areas are often regarded as "niche," our skillsets make a huge impact on our patients. I think one of the best ways to honor that is to continue to build the evidence that supports what we do every day.

Stephanie Woelfel PT, DPT, CWS

President – Academy of Clinical Electrophysiology & Wound Management.

JCEWM 2023; 1(1): 5-7

APTA Journal of Clinical Electrophysiology & Wound Management

Editorial

A Look Back as We Move Forward

This month's launch of the new online JCEWM marks a new milestone for the Academy and is the perfect time for us to look back and see just how far we have come. In 1974, the American Physical Therapy Association (APTA) and the Canadian Physiotherapy Association held a joint meeting in Montreal. The APTA's House of Delegates also met during this time. The ACEWM started when the Maryland Chapter brought RC 24-74 before the House, requesting approval for the formation of a new section, the Section for Electrophysiological and Electrokinesiological Measurements.[1] The motion stated the purpose of the new section was to "provide a means of stimulation, education, and coordination of physical therapists interested in electrophysiological and electrokinesiological measurements."1 The motion passed and our history began. Two other sections were approved during that session: the Section on Orthopaedics and the Section on Pediatric Physical Therapy.

The newly approved Section for Electrophysiological and Electrokinesiological Measurements held its first official meeting in Montreal on June 16, 1974. With dues at $5.00 per year, 31 inaugural members were in attendance, and our first elected officers set their hearts and minds toward developing this fresh, new component of the APTA:[2]

Dean Currier, Chairman

Arthur Nelson, Vice Chairman

Rodney Schlegel, Recording Secretary

Joseph Hayden, Treasurer

Willard Meier, Corresponding Secretary

The Section's stated purpose was quickly expanded to include interests in "biofeedback, functional anatomy, research, and clinical tests."[2] A year later, almost to the day, the Section held its second annual business meeting on June 15th at the Disneyland Hotel in Anaheim, CA, in conjunction with the 1975 APTA Annual Conference.[3] At that time, the Section for Electrophysiological and Electrokinesiological Measurements was one of only 10 APTA sections.

As the Section grew, the name evolved to better reflect the interests of its members and contemporary terminology, dropping Electrokinesiological Measurements from the name. On February 1, 2005, the name was changed from the Section on Clinical Electrophysiology to the Section on Clinical Electrophysiology and Wound Management (SCEWM). This change in name clearly designated the SCEWM as the official "home" for APTA members involved in wound management and the Section's membership exploded. Just three years after the name change, membership numbers almost tripled, increasing from the 300s to just over 1,000 members.

On May 19th, 2015, our name changed again, moving us away from a "section" or component description to an "academy." The term "academy" is defined as a "body of established opinion widely accepted as authoritative in a particular field."[4] The new official name was launched, Academy of Clinical Electrophysiology and Wound Management, APTA, Inc. (ACEWM). Our current name provides a much better description of the highly educated, experienced, and specialized nature of our members.

The evolution of our name reflects how our focus, membership, and areas of specialty practice have changed over time. The ACEWM is unique from all other APTA sections and academies in that it exists solely from the collaboration of its four special interest groups (SIGs): Biophysical Agents, Electrodiagnostics, Neuromusculoskeletal Ultrasonography, and Wound Management. Each of our SIGs, though small individually, come together so that all our members can be equally represented on a national level. Another unique feature of the ACEWM is that it is the only APTA section or academy represented by two American Board of Physical Therapy Specialties (ABPTS) clinical specializations:

1. Clinical Electrophysiology – approved by the House in 1982 with the first exam administered in 1986 with over 200 certified clinical electrophysiologic specialists

2. Wound Management – approved by the House in 2019 with the first exam administered in 2022 with 12 certified clinical wound management specialists

Changing and growing requires good leadership, and the ACEWM has had multiple official and unofficial influential leaders over the years, starting with those first pioneers who took on the task of creating a brand-new section in 1974. Below is a partial list of past leaders that played a significant role within the Academy:

Elaine Armantrout	Rose Hamm	Michael Nolan
Carrie Sussman	Dean Currier	Robert M. Kellogg
Andrew Robinson	Pamela Unger	Jack Echternach
Luther Kloth	Rodney Schlegel	Lynda Woodruff
Meryl Gersh	Charlene "Billie" Nelson	
Robert Sellin	David Greathouse	
Mike Skurja	Rick Nielsen	

Congratulations to the Academy on launching the new online Journal of Clinical Electrophysiology and Wound Management (JCEWM). This initial edition marks another step forward in the almost 49-year history of the ACEWM. We have come a long way from that meeting in Montreal!

References:

1. American Physical Therapy Association. RC 24-74. Vote #9. HOD Summary of Proceedings. 1974;11.

2. American Physical Therapy Association. House approves new sections. Progress Report. 1974;3(6).

3. American Physical Therapy Association. Sections plan activities for annual conference. Progress Report. 1974;3(9):4.

4. Merriman Webster Dictionary. Available at www.http/merriam-wenbster.com. Accessed January 3, 2023.

Karen A. Gibbs, PT, DPT, PhD, CWS

Immediate Past President – Academy of Clinical Electrophysiology & Wound Management.

JCEWM. 2023, 1. 10.55566/JCEWM-D-23-00005

JCEWM 2023 ;1(1),8-29

ACEWM official document

Introducing the Newly Revised, Consensus-Based, Entry-Level Wound Management Curriculum Recommendations

We are excited to present the newly revised *2023 Entry-Level Physical Therapist Curriculum Recommendations for Integumentary/Wound Management*. The new document is based on a 3-Round Delphi project conducted by Karen Gibbs, Deborah Wendland, Kathryn Panasci, and a group of DPT student researchers from Texas State University: Hope Martinez, John Mantanona, Melinda Powers, and Rachael Sausman. This latest version of the wound recommendations has been completely reorganized to increase clarity and usability. Thank you to all those that participated in the consensus-building process that facilitated these updates.

2023 Entry-Level Physical Therapist Curriculum Recommendations for Integumentary/Wound Management

Academy of Clinical Electrophysiology & Wound Management: Wound Management Special Interest Group

A component of the American Physical Therapy Association

Ever advancing knowledge and technology drives change in healthcare education and practice. Subsequently, integumentary/wound management-related knowledge and skill expectations for entry-level physical therapists continue to grow and expand.

The Academy of Clinical Electrophysiology and Wound Management's (ACEWM) Wound Management Special Interest Group (WMSIG) present the following recommendations to support academic and clinical faculty in developing, updating, and implementing a robust entry-level integumentary/wound management curricular plan. These consensus-based recommendations were developed through a Delphi process in 2022-2023 and represent the opinions of academic and clinical faculty from across the country.

Recognizing that education programs dedicate varying amounts of time to integumentary/ wound management content, topics are divided into "Need to Include" and, where applicable, "Nice to Include" categories to assist faculty in prioritizing content based on available contact hours.

It is important to recognize that some general "Need to Include" recommended content items are applicable across practice settings (e.g., systems screening, patient history) and likely are, or could be, included in other areas of the curriculum. In this case, previously covered content can be efficiently reviewed/applied/integrated during integumentary-specific instruction. Faculty communication and collaboration across entry-level courses is highly encouraged.

The 2023 curriculum recommendations continue a long history of the ACEWM WMSIG working to promote contemporary education for entry-level physical therapists. Early foundational recommendations were created and published 25+ years ago, with revisions in 2008 and 2014, and served as a strong foundation for the 2023 update. The ACEWM appreciates the continued partnership between members, educators, and clinicians working to keep this document applicable to contemporary practice. Thank you to all that have contributed!

Table of Contents

NORMAL TISSUE HEALING

Anatomy of the Skin

Need to Include
Function of skin
Layers of skin, including primary cells & vascular supply

Example lab activity:

- Review burn injury depths (superficial, superficial & deep partial thickness, full thickness, subdermal) based on skin layer involvement & scar risk.

Example learning objectives:

- Identify structural components of the skin.
- Define terms associated with wound depth, including superficial, partial thickness, and full thickness.

Physiology of Healing

Need to Include
Activation of platelets & the process of hemostasis
Growth factors
Normal physiology of tissue healing, including phases of healing & general timeframes
Primary cells
Types of wound closure

Example lab activity:

- Identification of healing phases using wound photographs.

Example learning objective:

- Describe the function of primary cells active in tissue healing to include: platelets, mast cells, neutrophils, macrophages, endothelial cells, fibroblasts, myofibroblasts, & epithelial cells.

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Factors That Can Negatively Impact Tissue Healing

Need to Include
Local factors
Nutrition & hydration
Systemic factors

Example lab activity:

- Large & small group discussion to identify complicating factors presented in a case study & how to mitigate.

Example learning objective:

- Provide patient education regarding how factors that may impede tissue healing can be altered.

PSYCHOLOGICAL ISSUES

Possible Concerns

Need to Include	Nice to Include
Barriers to care (e.g., language, resource availability, funding, social support)	Cosmesis & self-image
Effects of chronic illness	Palliative care
Effects of isolation	Sleep
Healthcare expenses & lost wages	
Mental health	
Occupational & lifestyle changes	
Quality of life	
Social habits	
Stress (patient, family, caregiver)	

Example lab activity:

- Identify potential local sources of support for patients, family, or caregiver(s) dealing with psychological issues.

Example learning objective:

- Discuss possible effects of chronic illness including stress, anger, depression, financial stress, isolation, & dependence on a patient's ability to deal with open wounds.

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EXAMINATION

Patient History

Need to Include
Allergies & sensitivities, including latex, sulfa, adhesives, etc.
Current condition(s)/chief complaint(s), including patient needs, concerns, & current/prior wound interventions
Employment/work
Family history
General demographics including age, height, & weight
General health status & function, including self-care/ADLs & domestic responsibilities; education; work; & community, social, civic life
Growth & development
Imaging
Injury/disease including onset, mechanism, course of events, symptoms, patient/family/caregiver expectations, and goals
Lab values
Living environment & destination at conclusion of care
Medications (e.g., steroids, antibiotics, anticoagulants, chemotherapy, radiation, insulin, nonsteroidal anti-inflammatory drugs (NSAIDS), analgesics, herbals, home remedies)
Past medical/surgical history (e.g., cardiovascular, endocrine/metabolic, gastrointestinal, genitourinary, previous wounds/dermatologic conditions, musculoskeletal, neuromuscular, & prior hospitalizations)
Social habits & behavioral health risks, including tobacco, alcohol, drug abuse, & fitness
Social history including culture, resources, activities, & support systems

Example lab activity:

- Create a patient evaluation template, complete a full examination including history using wound models and/or simulation activities.

Example learning objective:

- Explain issues surrounding a patient's level of function & mobility & how these factors influence wound healing potential.

Gross Screening of Systems

Need to Include
Cardiovascular
Cognitive
Gastrointestinal
Genitourinary
Integumentary
Lymphatic
Musculoskeletal
Neuromuscular
Pulmonary

Example lab activity:

- Perform basic systems review screening (e.g., vital signs, range of motion, strength, gross motor function, breath sounds, girth, gross postural & skin assessment).

Example learning objective:

- Summarize how wound healing can be negatively impacted by deficits in one or more body systems.

Wound Characteristics

Need to Include	Nice to Include
Classification based on: • Depth of tissue destruction • Etiology & wound type, including Wagner Scale & pressure injury staging • Tissue color	Surface area – Lund & Browder
Drainage/exudate, including type, amount, consistency, & odor	
Photo documentation	
Wound bed/margins, including tissue type, color, quality, presence of anatomical structures, & phase(s) of healing	
Wound dimensions: • Depth • Surface area (length x width), including Rule of Nines • Tunneling, sinus tract • Undermining	

Example lab activity:

- Wound measurements: create wounds in fruit with various shapes, depth, tunnels, & undermining

Example learning objective:

- Perform accurate wound measurement using wound models.

Periwound & Surrounding Skin

Need to Include	Nice to Include
Ecchymosis	Denuded Skin
Edema, pitting edema	Fissures
Epibole	Pruritis
Erythema	Scar assessment scales
Excoriation	Turgor
Fungal infection	Xerosis
Girth	
Hemosiderin staining	
Hyperkeratosis, callus	
Induration	
Lymphedema	
Maceration	
Periwound coloration	
Scarring	
Tenderness to palpation	

Example lab activity:

- Using wound photos, match periwound descriptors & link to possible interventions.

Example learning objective:

- Discuss options for identifying erythema in darkly pigmented skin.

Pain Specific to Open Wounds

Need to Include	Nice to Include
Baker Wong Faces Scale	McGill Pain Questionnaire
Impact of pain on function	
Quality of sleep	
Types of pain: • Background • Incident • Neuropathic • Nociceptive/acute • Operative • Procedural	
Visual Analog Scale (1-10)	

Example lab activity:

- Practice screening for & determining the type of pain during mock patient cases.

Example learning objective:

- Compare & contrast the different types of pain & give examples of how these might be mitigated.

General

Need to Include
Balance
Community, social, civic life
Education & work/life activities
Footwear
Joint integrity
Mobility
Muscle performance
Range of motion
Reexamination, including repeat of selected tests/measures
Self-care, ability to perform basic ADLs
Use of assistive technologies, including offloading devices

Example lab activity:

- Build a template for wound examination including general screens/assessments.

Example learning objective:

- Incorporate general patient screening into wound examination.

Vascular Testing

Need to Include	Nice to Include
Ankle-brachial index (ABI)	Buerger's test
Assess distal pulses	Knowledge only: • Digital photoplethysmography • Lower extremity angiography • Toe brachial index • Transcutaneous pulse oximetry
Blanch testing	Venous filling time
Capillary refill	WiFi (wound, ischemia, foot inspection)
Rubor of dependency	
Visual inspection	

Example lab activity:

- Perform a full lower extremity noninvasive vascular screen including skin assessment, pulses (femoral, popliteal, dorsalis pedis, posterior tibialis), temperature, capillary refill, Rubor of dependency, & ABI (depending on Doppler availability).

Example learning objective:

- Utilize ABI results when developing an intervention plan for a patient with vascular insufficiency.

Pressure Risk Assessment

Need to Include	Nice to Include
Braden Scale - For Predicting Pressure Sore Risk	Braden Q
Knowledge only: • Pressure mapping	Gosnell Scale - For Predicting Risk of Pressure Ulcer
	Norton Pressure Ulcer Risk Scale
	PUSH

Example lab activity:

- Revisit wheelchair assessment (with focus on pressure risk) given various patient mobility scenarios.

Example learning objective:

- Select and perform appropriate risk assessment(s) based on mock patient cases.

Sensory Integrity

Need to Include	Nice to Include
Deep pressure	MNSI (Michigan Neuropathy Screening Instrument)
Kinesthesia	
Light touch	
Position sense	
Semmes-Weinstein monofilament testing	
Sharp/dull	
Temperature	
Vibration	

Example lab activity:
- Assess protective sensation using vibration & monofilament testing.

Example learning objective:
- Perform protective sensation screening of the foot.

Infection

Need to Include	Nice to Include
Infection-related laboratory markers/values	Impact of pharmaceuticals on infection
Signs & symptoms of: • Biofilm • Cellulitis • Local & spreading infection • Lymphangitis • Osteomyelitis • Systemic infection & sepsis	Knowledge only: • Fluorescence imaging • Tissue biopsy
Swab cultures	
Tests & measures to identify infection	

Example lab activity:
- Sterile field set up.

Example learning objective:
- Perform a sterile field set up.

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Various Wound Diagnoses

Need to Include	Nice to Include
Abscess	Calciphylaxis
Allergic reactions	HIV/AIDS
Burns	Hydradenitis suppertiva
Charcot Foot	MARSI (medical adhesive related skin injury)
Contact dermatitis	Medical device-related pressure injuries
Malignancy, cancer	Mucosal pressure injuries
Neuropathic ulcers	Necrotizing fasciitis
Skin Tears	Peritonitis
Stasis dermatitis	Psoriasis
Surgical	Pyoderma gangrenosum
Traumatic	Rheumatoid
Vascular: • Arterial insufficiency • Venous insufficiency	Scleroderma
	Shingles/Chicken Pox
	Sickle cell disease
	Systemic Lupus Erythematosus
	Vasculitic

Example lab activity:

- Utilize various wound photos & patient histories for differential diagnosis practice.

Example learning objective:

- Differentiate between various types of wounds and correlate wound characteristics with possible etiologies.

INTEGUMENTARY/WOUND MANAGEMENT INTERVENTIONS

Pain Management

Need to Include	Nice to Include
Deep breathing	Home remedies
Distraction	Monochromatic infrared energy
Electrical stimulation	Music
Impact of dressing selection & removal, including moisture retentive	Non-contact ultrasound
Pharmacological: • Over the counter • Topical	Pharmacological: Prescription (IV, intramuscular, oral)
Rapport, empathy	Pain neuroscience education (PNE)
Rest breaks	

Example lab activity:

- Integrate selection & application of pain minimization techniques into case study activities.

Example learning objective:

- Summarize various techniques for minimizing pain during wound interventions.

Infection Control Measures

Need to Include
Aerosolization risks with irrigation & low frequency ultrasound
Cleaning & disinfection of equipment
Hand hygiene, soap & water versus sanitizer
Isolation, including organism-specific (e.g., contact, droplet, airborne)
Sterile versus clean technique
Standard precautions
Use of personal protective equipment (PPE)

Example lab activity:

- Practice donning/doffing gowns, exam gloves, and sterile gloves.

Example learning objective:

- Compare & contrast PPE requirements based on patient history & diagnosis, wound type, & intervention.

Wound Cleansing

Need to Include	Nice to Include
Wound cleansers	Scrubbing
Wound cleansing/irrigation, including type, method, amount, & temperature	

Example lab activities:
- Utilize monojects & catheters to irrigate wound models.
- Practice pulsed lavage with suction (if portable suction is available).

Example learning objective:
- Compare & contrast various methods of wound cleansing, irrigation, & hydration & when each would be appropriate based on wound status.

Debridement

Need to Include	Nice to Include
Methods of debridement: • Autolytic • Enzymatic • Mechanical • Sharp (knowledge only) • Surgical (knowledge only)	Methods of debridement: • Biosurgical (maggot - knowledge only) • Chemical • Ultrasound (knowledge only)
Special considerations (e.g., lab values, pain)	

Example lab activity:
- Practice debridement methods using fruit (e.g., oranges, avocados), pig's feet, and/or cadavers.

Example learning objective:
- Compare & contrast various forms of debridement & select when each would be appropriate based on case scenarios.

Non-Antimicrobial Dressings

Need to Include	Nice to Include
Absorbent pads	Burn pads
Calcium alginate	Composite
Collagen	Growth factors
Foam	Skin substitutes
Gauze	
Hydrocolloid	
Hydrofiber	
Hydrogel	
Non-adherent contact layer	
Primary/secondary dressings	
Transparent film	

Example lab activity:

- Demonstration/practice of dressing application on wound models.

Example learning objective:

- Compare & contrast dressing characteristics.

Infection Management

Need to Include	Nice to Include
Antimicrobial dressings, including silver	Cadexomer iodine
Biofilm management	Honey
Debridement to decrease potential/current infection	
Inappropriate use of occlusive dressings in presence of infection	
Topical solutions, including acetic acid, Dakin’s solution, hydrogen peroxide, & povidone-iodine	

Example lab activity:

- Practice parameter selection & application techniques of available modalities appropriate for management of infection (e.g., pulsed lavage with suction, wound cleansing/irrigation, electrical stimulation, noncontact ultrasound).

Example learning objective:

- Select appropriate irrigation solutions & dressing(s) for infected wounds based on patient history & wound characteristics.

Biophysical Agents

Need to Include	Nice to Include
Electrical stimulation	Hyperbaric oxygen
Negative pressure wound therapy	Low frequency ultrasound
Pulsatile lavage (with/without suction)	Pneumatic compression
	Shockwave therapy
	Traditional ultrasound
	Ultraviolet light

Example lab activity:

- Practice parameter selection & application of high volt pulsed current electrical stimulation based on various patient scenarios.

Example learning objective:

- Apply negative pressure wound therapy & explain rationale for parameter & dressing decision.

Pressure Redistribution

Need to Include	Nice to Include
Footwear needs & options	Seating/pressure mapping
Management of incontinence	
Mobility training	
Offloading	
Orthotic devices	
Support surfaces	
Therapeutic positioning	

Example lab activity:

- Place colored dots over bony landmarks at highest risk for pressure injury in various positions (e.g., supine, prone) & have students apply offloading principles to mitigate risk.

Example learning objective:

- Identify pressure injury risk factors & describe pressure redistribution techniques & devices appropriate to address these risks.

Other

Need to Include	Nice to Include
Bandaging techniques	Bandaging – Montgomery straps
Compression: • Ace wrap • Compression garments • Long stretch • Multi-layer • Short stretch	Removal of sutures & staples
Control of bleeding	
Exercise prescription	
Knowledge only: • Manual lymph drainage • Total contact casting (TCC)	
Management of incontinence	
Periwound management	
Possible adverse reactions	
Scar management	
Skin care	
Skin sealant/protectant	

<u>Example lab activity</u>:
- Practice figure of eight & spiral wrapping techniques & apply multi-layer compression.

<u>Example learning objective</u>:
- Prescribe an exercise plan based on loss of muscle tissue associated with traumatic injury.

DOCUMENTATION

Need to Include
Daily treatment notes
Diagnosis
Discharge summary
Evaluation
Goals
History
Patient education topics
Plan of care
Prognosis
Re-evaluation
Referrals
Systems review
Tests/measures

Example lab activity:
- Add documentation to existing case studies/patient scenarios.

Example learning objective:
- Utilize correct wound-related terminology in completing accurate, timely wound documentation.

HEALTHCARE PROVIDER RISK

Need to Include
Post exposure procedures
Provider immunizations
Reduction/prevention of infection transmission
Sharps
Standard & isolation precautions, including contact, droplet, airborne (knowledge only)
Tuberculosis & blood borne pathogen standards/training
Use of personal protective equipment (PPE)
Work practice controls/hazard communication

Example lab activity:
- Practice don/doff of PPE.

Example learning objective:
- Describe basic PPE/OSHA standard precautions required in various patient scenarios.

INTERDISCIPLINARY TEAM

Possible Members of a Wound Management Team

Need to Include	Nice to Include
Advanced practice providers (Physician Assistant, Nurse Practitioner)	Diabetic Educator
Case manager	Infection prevention professional
Dietician	Pharmacist
Durable Medical Equipment (DME) Providers	Podiatrist
Nurse	Smoking cessation specialist
Orthotist/prosthetist	
Physical therapist/physical therapist assistant	
Physician/surgeon, from all relevant specialty areas	
Social worker	

Example lab activity:

- Based on patient scenarios, discuss other healthcare professional team members necessary to optimize patient care.

Example learning objective:

- Determine when patient needs extend beyond the scope of physical therapist practice & recommend referral to collaborative healthcare professionals.

WOUND MANAGEMENT BUSINESS & ADMINISTRATION

Exposure to Reimbursement Issues

Nice to Include
Coding: overview of Healthcare Common Procedural Coding System (HCPCS)
Local Coverage Articles (LCAs)
Local Coverage Determinations (LCDs)
Medicare Administrative Contractors (MACs)
National Correct coding Initiative (NCCI)
National Coverage Determinations (NCDs)
Overview of Medicare - Minimum Data Set (MDS)
Patient-Driven Groupings Model (PDGM)
Patient-Driven Payment Model (PDPM)

Example lab activity:

- Utilize LCD information to answer questions about a patient's plan of care.

Example learning objective:

- Summarize various issues related to wound management reimbursement.

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Original Research

Comparison of electrically elicited quadriceps torque: burst modulated biphasic pulsed current (BMBPC) versus the Kneehab™ XP garment stimulator

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[1] Husson University School of Physical Therapy, ME

Purpose

Neuromuscular electrical stimulation (NMES) is the use of electrical current to generate muscle contractions for the purpose of increasing strength. Typically, discomfort limits the current amplitude tolerated and consequently how much force the recruited muscle produces, which influences strength adaptations. The purpose of this study was to compare the maximally tolerated knee extensor muscle torque produced by two neuromuscular electrical stimulation devices: the Vectra Genisys® stimulator delivering a burst modulated biphasic pulsed current (BMBPC) and the Kneehab™ XP (KH) garment sleeve that delivers a biphasic pulsed current (BPC).

Methods

For 28 abled bodied participants we compared the percent of the knee extensor maximal volitional isometric torque (%KEMVIT) produced by the BMBPC of the VG and BPC of the KH. This was determined by measuring the maximally tolerated electrically elicited muscle torque normalized to their KEMVIT.

Results

Our results showed a significant main effect for the devices on %KEMVIT. The BMBPC of the VG produced significantly greater %KEMVIT, 38.1 ± 14.9, than the BPC of the KH, 29.3 ± 9.9 (P =.001). A majority of the participants (23/28) described the BPC of KH as more comfortable than the BMBPC of the VG.

Clinical Implications

For eliciting maximum knee extensor torque, the VG clinical stimulator delivering BMBPC was more effective than the BPC of the KH garment stimulator. However, the KH was preferred by 23 of the 28 (82%) participants likely because of the lower muscle torques produced.

Keywords: Kneehab, Vectra Genysis, Neuromuscular Electrical Stimulation, Quadriceps Femoris Muscle

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1. Introduction

Neuromuscular electrical stimulation (NMES) is a clinical modality commonly used to treat muscle atrophy and promote neuromuscular re-education in order to increase strength. NMES stimulates peripheral motor neurons usually via electrodes placed on the skin to transcutaneously recruit muscle fibers.[1] NMES has often been used to increase the size and strength of the atrophied and weak quadriceps femoris muscle following ACL reconstruction and total knee arthroplasty.[2-5]

The electrically elicited muscle torque a person can tolerate from NMES is often limited by discomfort.[1,6,7] Medeiros et al.[8] compared the knee extensor muscle torque from four different types of NMES and while the maximum torque that was produced varied, there was no difference in the discomfort reported at the maximum tolerated current intensities, suggesting that discomfort itself was the limiting factor and that different types of NMES affect discomfort. These findings are consistent with other reports that the electrical stimulation parameters of NMES can affect the torque produced at the maximum tolerable current amplitude a person is willing to tolerate.[1,6,9,10] It is desirable to produce the greatest electrically elicited muscle torques possible because there is a dose-response relationship between the electrically elicited muscle torques produced by NMES and subsequent increases in strength.[1,11-13]

One NMES waveform that has demonstrated the ability to evoke relatively high muscle torques at the maximal tolerated current intensity is the burst modulated biphasic pulsed current (BMBPC). This waveform is available on the Vectra Genysis® (DJO Global, LLC, Lewisville, TX) clinical stimulator under the VMS burst™ selection. Adams et al.[9] found that 1000-Hz BMBPC and 1000 Hz burst modulated alternating current to be more effective waveforms for maximizing knee extensor torque than 2500 Hz burst modulated alternating current, known clinically as Russian current. Bellew et al.[10] also found BMBPC utilizing a 1000 Hz carrier frequency produced significantly greater percent maximal knee extensor isometric muscle force than 2500 Hz carrier frequency BMBPC. Based on these findings the 1000 Hz carrier frequency BMBPC appears to be a highly effective, clinically available waveform to generate maximal electrically elicited knee extensor torque.

The Kneehab™ XP Conductive Garment System (Theragen, LLC, Leesburg, VA) electrical stimulation device, which recently has become available in the United States, utilizes four electrodes within a battery-powered thigh sleeve garment that offers 6 preset stimulation programs with options for different stimulation frequencies and on/off times for repeated contractions. All of the programs utilize a biphasic pulsed current (BPC). Rather than using the unidirectional current flow that is typical of most NMES devices, the Kneehab (KH) uses a multipath current flow that is designed to alternate the location of the electrical current among 4 electrodes of varying sizes to reach a larger number of motor units with less discomfort.[6,7] It has been demonstrated that the KH can be an effective NMES device to produce muscle hypertrophy and improvements in knee extensor strength.[2,14,15] Furthermore, it has been suggested that the KH may be superior to traditional unidirectional NMES in producing higher muscle torques at the maximum tolerated current amplitude,[6,7] and better functional outcomes following ACL reconstruction surgery.[2] However, there has not been a study comparing muscle torques at the maximally tolerated current intensity between the BMBPC of the VG and the BPC of the KH. The purpose of this study was to compare the electrically elicited knee extensor muscle torques produced by the VG clinical stimulator delivering 1000 Hz BMBPC and the KH delivering BPC at the maximum current amplitude participants were willing to tolerate.

2. Materials and Methods

We recruited thirty participants from Husson University and the surrounding community. Participants with a history of cardiovascular disease, neurological disease, implanted electrical devices, or musculoskeletal dysfunctions of the right thigh or knee were excluded. All participants signed a written informed consent form. The Institutional Review Board of Husson University approved the study (#17PT03).

In this single blind, crossover design study, each participant underwent testing on the right leg with two NMES units. One unit was a Vectra Genisys® (VG) stimulator set to deliver the VMS burst™, a BMBPC with a carrier frequency of 1000 Hz, a phase duration of 400 microseconds, interphase and interpulse intervals of 100 microseconds, and a peak current output of 120 mA. The stimulation parameters of the VG stimulator were selected to closely match those of the KH program 6. Both stimulators delivered a biphasic square waveform for 6 seconds at a rate of 70 bursts (VG) or pulses per second (KH), via

2 channels. Ramp-up time was 1 second and ramp-down time was 0.5 seconds for both stimulators as well.

The VG utilized four round surface electrodes (Bodymed® Hudson, OH) with a diameter of 7.5 cms and a surface area of 44.2 cm² each for a total surface area of 176.7 cm². The electrodes for channel 2 were placed along the vastus medialis muscle. The distal electrode was positioned at 80% of the distance between the anterior superior iliac spine and the medial joint line of the knee, and the proximal electrode placed 15 cm above the distal. Channel 1 electrodes were placed along the vastus lateralis muscle; with the distal electrode positioned 2/3 of the distance between the anterior superior iliac spine and the lateral border of the patella, and the proximal electrode positioned 15 cm above the distal. The VG delivered the BMBPC as unidirectional current between the proximal and distal electrodes of each channel concurrently with a maximum current output of 120 mA (Figure 1).

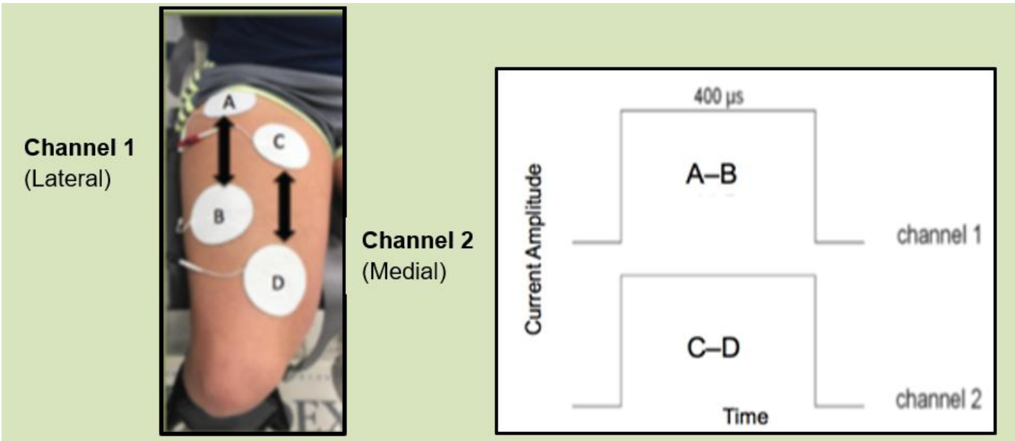

Figure 1. An image depicting the unidirectional pathway mechanism of the Vectra Genisys®.

The other NMES unit was the Kneehab™ XP Conductive Garment System that utilizes a multipath system with biphasic square pulsed current with phase durations of 100-400 µsec with a maximum current output of 70 mA. Stimulator parameters were set by selecting program 6 which consisted of electrical stimulation of 70 pulses per second, a ramp-up time of 1 second and a ramp-down time of .5 second. We used the manual trigger function to allow for the 6-second contractions as the program uses 10-second contractions with 50 second rests. The KH generates multiple dynamically changing pathways within single pulses, with a temporal shift between pairs of electrodes for the first channel utilizing electrodes A–C and A–D for the first 300 µs followed by A–B for the last 100 µs of each pulse (400 µs total) and for channel 2, 100 µs pulses between electrodes D-A, D-B and D-C.[6,16] A pictorial representation of the KH waveform is shown in Figure 2. Adhered to the inner surface of the KH sleeve are four reusable adhesive hydrogel electrodes having surface areas of 194 cm², 83 cm², 74 cm² and 66 cm² respectively for a total area of 417 cm².[2,15] Figure 3 shows a participant with the KH in place. We fitted each participant for the KH cuff during a preliminary meeting. We adjusted the electrode placement within the garment to accommodate the length and girth of the thigh as per the instructions accompanying the device.

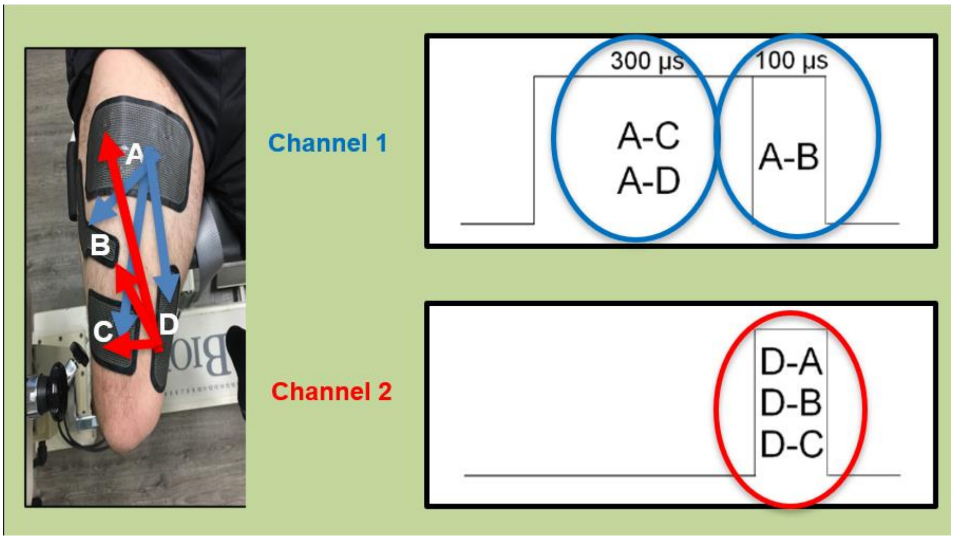

Figure 2. An image depicting the multipath system of the Kneehab™

Figure 3. Kneehab™ XP Conductive Garment System in place

Prior to testing, we recorded the participants' height, weight, and blood pressure. Participants then warmed up on a cycle ergometer for 5 minutes. Next, we positioned the participants in a Biodex electromechanical dynamometer to measure right knee extension muscle torque. Participants sat on the dynamometer with the knee flexed to 90 degrees, and we secured a pad to the anterior distal aspect of the lower leg approximately one inch superior to the ankle malleoli. We aligned the axis of rotation of the dynamometer lever arm with the lateral epicondyle of the femur. To determine the knee extensor maximum voluntary isometric torque (KEMVIT) participants performed a minimum of 3 maximal voluntary isometric contractions with verbal encouragement and 60 seconds of rest between each trial. If the peak torque produced during the third trial was more than 5% greater than the first two trials, participants continued to perform additional trials until the peak torque did not increase by more than 5% compared to the previous trials. The maximum peak torque produced during the contractions was used to normalize the peak torque generated during the two NMES test conditions as a percentage of knee extensor maximal voluntary isometric torque (% KEMVIT). Following KEMVIT testing, based on a predetermined schedule of alternating conditions either the KH was donned, or four surface electrodes were placed over the quadriceps muscles of the anterior thigh for the VG.

We informed participants that the goal of the study was to measure how much torque their thigh muscles could produce with the two stimulators. During the stimulation, we instructed participants to "relax and let the stimulation make your muscle contract." An 11-point (0-10) numeric pain rating scale, where 0 represented "no pain" and 10 represented the "worst pain imaginable" was used. After each 6-second contraction we asked participants for a pain rating. We stopped testing when participants reached either their maximum acceptable pain level, or reported a 7 on the pain rating scale (which participants were aware would end the testing) or the stimulator reached its maximum output.

We increased the amount of current delivered in 10 mA increments for the VG (range 0 to 120 mA) and 10-unit increments for the KH (0 – 99 corresponding to a range of 0 to 70 mA) from contraction to contraction. Due to the way both of the stimulator's work, the intensity could only be increased when the current was flowing. Consequently, the stimulation intensity was increased to the next target value during a brief contraction, and then stopped for approximately a 60-second rest followed by delivery of a stimulation train for the full 6 seconds. Consequently, each brief intensity-setting train alternated with a full 6-second train from which the peak torque was recorded. We delivered the stimulation trains manually approximately every minute.

We then tested the other stimulator following a 5-minute rest period. During the testing, participants were blinded with respect to their muscle torque output. Following testing of the second stimulator, participants rested for 5 minutes and then performed the KEMVIT testing again. We asked participants to report perceived differences in comfort between the two devices.

Analysis was completed in Microsoft Office Excel 2016 and IBM SPSS (Statistical Package for the Social Sciences v. 24.0, IBM Corporation, Armonk, NY 10504). We set the level of significance for all analyses at $P < 0.05$. We used an analysis of variance (ANOVA) for crossover studies to analyze the electrically elicited isometric quadriceps torque produced at the maximum tolerated current amplitude, expressed as a percentage of maximal voluntary isometric torque, %KEMVIT. The factors in this model included participants, condition (BMBPC of the VG or BPC of the KH), and period (order of application: first or second). We used a paired t-test to compare the pre-KEMVIT to post-KEMVIT.

3. Results

Thirty participants completed the study. Many of the participants were students in a Doctor of Physical Therapy program who had prior exposure to electrical stimulation. Other participants were students in other programs or members of the community who had little or no prior exposure to electrical stimulation. All testing was done in a single session, there was no prior session to familiarize the participants with the NMES. We did not record the training status of the participants or ask them to avoid strenuous activity for some period of time prior to testing. We excluded two participants due to poor tolerance of NMES; therefore, we analyzed data for 28 participants (15 males, 13 females). The mean age of all participants was 23.6 years old with a range from 21 to 41 years old.

Concerning our primary dependent variable of %KEMVIT, an ANOVA for crossover studies yielded a significant effect, $P = 0.001$, for condition (BMBPC or KH), but no significant effect, $P = 0.582$, for period (device administered first or second). On average, the BMBPC yielded significantly greater %KEMVIT, mean = 38.1 ± 14.9, than the KH, mean = 29.3 ± 9.9. The effect of device on %KEMVIT is illustrated in Figure 4. A paired t-test revealed the pre-KEMVIT was significantly greater than the post-KEMVIT ($P < 0.001$). On average, the pre-KEMVIT was 250.5 ± 33.2 Newton meters and the post-KEMVIT was 206.1 ± 25.6 Newton meters (Figure 5).

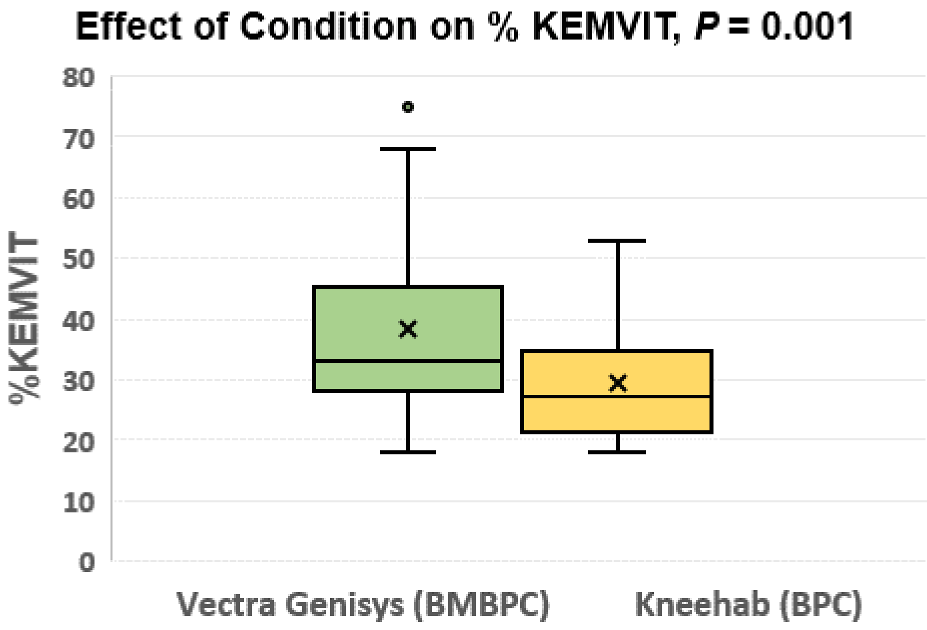

Figure 4. Effect of stimulation device on %KEVMIT

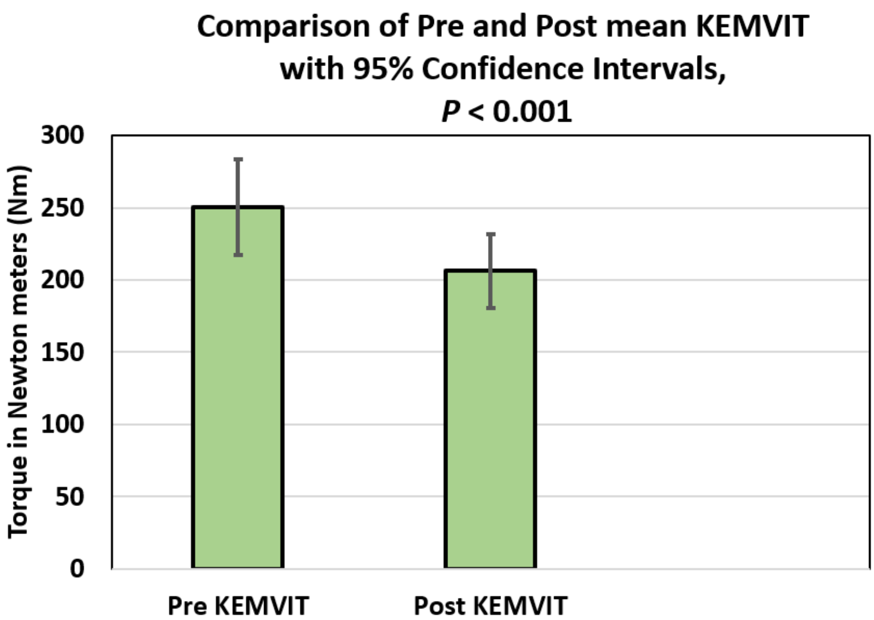

Figure 5. Comparison of pre and post stimulation KEMVITs

All participants (28/28) reached their maximum pain tolerance with the BMBPC delivered by the VG prior to reaching the maximum current output of the device. Only 4 participants reached their maximum tolerance using the KH, while the remaining 24 participants reached the maximum current output of the device first. Consequently, the pain ratings when testing was terminated were compared using a paired t-test. The pain ratings for the KH were significantly lower (5.1 ± 1.2) than those of the BMBPC delivered by the VG (7.0 ± 0.2, $P < 0.001$). Twenty-three participants reported favoring the KH, 1 participant favored the BMBPC, and 4 participants stated no preference for either device. All 4 participants who reached their maximum tolerated current amplitude with both the VG and the KH reported preferring the KH.

4. Discussion

Our purpose in conducting this study was to compare the electrically elicited knee extensor muscle torques at the maximal level of discomfort participants were willing to tolerate between the 1000 Hz BMBPC of the VG and the BPC of the KH. We were not able to make this comparison because the KH lacked the ability to deliver sufficient current to reach 24 of the 28 participants' maximum tolerated current, whereas the BMBPC of the VG was able to reach all participants' maximum tolerated current. Consequently, while the comparison was between the maximum electrically elicited knee extensor torque produced by the two NMES stimulators this was always limited by discomfort for the BMBPC of the VG but was only the case for the BPC of the KH for 4 participants, with the other 24 limited by the KH current output. This finding is demonstrated by the significantly lower pain ratings reported in response to the BPC of the KH as compared to the BMBPC of the VG.

Our primary finding was that the BMBPC of the VG produced significantly greater electrically elicited knee extensor muscle torque than the BPC of the KH. This observation is in contrast to work by Maffiuletti, Vivodtzev, Minetto, and Place[6] and Morf, Wellauer, Casartelli and Maffiuletti[7] that demonstrated the multipath system of the KH stimulator was capable of producing greater knee extensor muscle torque than what they termed conventional NMES using unidirectional electrical stimulation. However, importantly, in both of those studies the KH was modified to be able to deliver a maximum current of 200 mA rather than the 70 mA of the commercially available KH unit used in this study. Maffiuletti, Vivodtzev, Minetto, and Place[6] reported the average maximum tolerated current amplitude with the KH was 92 ± 25 mA which is consistent with our observations that 70 mA is not enough current to reach the maximum tolerated level of discomfort for most persons with the KH. Another factor that may have contributed to the limited ability of the KH to reach participants' maximum tolerated current amplitude was a lower phase charge. At 70 mA the phase charge for the BMBPC of the VG was 28 μC per channel or 56 μC in total (Figure 1). At the same current output of 70mA for the BPC of the KH the phase charge for channel one was 21 μC for the first 300 μsec and 7 μC for the last 100 μsec while for channel 2 it was 7 μC for 100 μsec corresponding temporally with the final 100 μsec of channel 1 (Figure 2). Therefore, the total phase charge of the KH for both channels was 35 μC. This lower phase charge may have resulted in the recruitment of fewer motor units at a given current output level and therefore compromised the muscle torque produced.[17]

The only other study that compared the KH to a traditional unidirectional stimulator (Polystim, Biomedical Research Ltd., Galway, Ireland) is difficult to compare to this study due to significant methodological differences. Feil, Newell, Minogue, and Paessler[2] compared the unidirectional Polystim to the multipath KH as an adjunct to a standard rehabilitation therapy program following ACL reconstruction surgery. The electrical stimulation was superimposed on volitional isometric contractions during 3, 20-minute training sessions 5 days per week. Following 12 weeks of training the KH group as compared to the Polystim group and a control group that did not receive NMES produced greater gains in the strength of knee extensor muscles and greater improvements in multiple markers of functional improvement.[2] Of note, both the Polystim and KH were limited to a maximum current output of 70 mA.

Twenty-three out of 28 of the participants (82%) from the present study favored the BPC of the KH sleeve garment delivering multipath electrical stimulation in regards to comfort as compared to the BMBPC of the VG. This observation is not surprising given that only 4 of the participants reached their maximum tolerated current amplitude with the KH. However, the 4 participants that reached their maximum tolerated current amplitude with the BPC of the KH all reported a preference for that condition as compared to the BMBPC of the VG. Consequently, this study may support previous findings that multipath electrical stimulation is perceived as more comfortable than conventional uni-directional NMES.[6,7] Unfortunately, since the KH output was in arbitrary units of 0-99 and not in current amplitude we can't say if these participants tolerated more current with the multipath BPC of the KH or the BMBPC of the VG, although 3 of 4 actually had higher torque outputs from the BPC of the KH at the maximum tolerated current level. Another possible explanation for people finding the KH more comfortable is that the surface area of the electrodes of the KH were considerably greater than those used to deliver the BMBPC with the VG (417 cm^2 vs. 176.72 cm^2). Therefore, at any given current level the current density would have been lower for the KH, which is associated with less discomfort.[11]

The findings from this study may inform clinicians when making decisions regarding which NMES device to purchase or use as a strengthening adjunct during patient rehabilitation. Producing the greatest NMES elicited torque possible should be the goal in order to maximize the patients' strength gains.[1,11-13] Our observations suggest that the VG delivering 1000Hz BMBPC is a superior stimulator as compared to the KH for achieving this goal due to the limited current output of the KH.

This study is not without limitations. The design of the study to test both conditions during the same testing session was probably not ideal. Although there was no effect of period detected, the fact that the post testing KEMVITs were reduced indicates that the muscle force producing capacity was likely reduced by muscle fatigue in the course of the testing. This may have resulted in lower %KEMVITs than would have been produced otherwise. The participants in this study largely consisted of young, able-bodied college students. It may be the case that if the participants were older or recovering from knee injuries, and therefore likely to be relatively weak, the limited current output of the KH would be less of a limitation for recruiting a relatively high percentage of the force-generating capacity of their muscles.

5. Clinical Implications

In conclusion, for eliciting maximum knee extensor torque, the BMBPC delivered by the VG clinical stimulator was more effective than the KH garment stimulator. Although the KH was preferred by the majority of participants based on level of comfort, this was likely due to the lower muscle torques that were produced by the KH as participants reached the maximum current output level of the KH stimulator before reaching the maximum discomfort they were willing to tolerate. Therefore, clinicians need to be wary that when using the KH for patient populations, particularly relatively strong patient populations such as athletes, that the KH may compromise the efficacy of NMES strengthening.

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Original Research

Attitudes, perceptions, and expectations of a student special interest group in student members of a professional organization in the United States

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Introduction: Providing quality benefits and value to professional association student members is important for their long-term retention and can cultivate future association leadership. The purpose of this study was to determine the Academy of Clinical Electrophysiology and Wound Management (ACEWM) student members' attitudes, perceptions, and expectations of the ACEWM Student Special Interest Group (SSIG).

Methods: The research design was a cross-sectional survey administered online. The survey questionnaire was comprised of five demographic items and 10 Likert scale items and was sent to all student members of the ACEWM.

Results: The response rate was 31.3% (n=56). Data indicated that: students felt that SSIGs are valuable (71.2%), it is important to interact with other students with a similar career interest (93.3%), SSIGs should promote a culture of clinical excellence (96.6%), and it is important to network with expert clinicians with a similar career interest as theirs (98.3%). Most participants supported the idea of the SSIG offering programs on electrophysiology (71.2%), wound management (89.8%), biophysical agents (69.5%), and diagnostic ultrasound (69.5%) to supplement their DPT curriculum.

Conclusion: Student members of the ACEWM indicated that networking with other students and clinicians is valuable and that the SSIG should offer continuing education on each ACEWM specialty. The results may be used to guide the SSIG's future strategic planning on enhancing the SSIG's value and delivering meaningful benefits to student members. These results may also guide other APTA component SSIGs as well as other external professional organizations on how to enhance their student members' experience.

Keywords: student members, special interest group, survey

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1. Introduction

Student physical therapists and physical therapist assistants represented nearly 33% of the just over 100,000 total American Physical Therapy Association (APTA) memberships in 2019.[1] Providing quality benefits and value to student members is important for their long-term retention within the organization and can cultivate future association leadership. Currently, the APTA has 18 specialty sections (some referred to as academies) and 51 state chapters. The sections and state chapters are collectively referred to as components.[2] Each section and chapter may offer sub-component groups, referred to as special interest groups (SIGs), which provide members the ability to expand their clinical network.[3]

In addition to clinically focused SIGs, student SIGs (SSIGs) may be offered by the components to their student members.[4] SSIGs promote participation within the association, stimulate students' communication skills, and provide an avenue for students to build their professional network.[5] SSIGs exist in healthcare professional organizations, such as the American Medical Association (named as Medical Student Section) and American Psychiatric Association, and have emerged within entry-level physical therapy programs.[5–7] As of May 2022, 78.4% of APTA state chapters (40/51) have a SSIG; however, only three specialty sections or academies offer one to their members.[4] Although considered as a section of the APTA, the Academy of Clinical Electrophysiology and Wound Management (ACEWM) is a stand-alone organization whose membership consists of nearly 1,000 physical therapists, physical therapist assistants, physical therapy students, and physical therapist assistant students interested in biophysical agents, electrodiagnosis, neuromusculoskeletal ultrasonography, and wound management.[8] The ACEWM, together with the Private Practice and Pelvic Health sections, is one of three APTA sections offering a SSIG.[4]

Although SSIGs are offered by many of the APTA state-level components, limited data exist on students' engagement with them. The purpose of this study was to determine the ACEWM student members' attitudes, perceptions, and expectations of the ACEWM SSIG. The findings will improve the ACEWM's understanding of what student members perceive as valuable and what they expect out of their membership, providing recommendations to the ACEWM SSIG, other APTA component SSIGs, and other professional organizations on ways to improve their SSIG programming and enhance their student members' experience in a professional organization.

2. Methods

Participants

A convenience sample of all ACEWM student members (n=179), including both physical therapy students and physical therapist assistant students, at the time this study was conducted, were invited to participate via email. Inclusion criteria required participants to hold an active student membership in the ACEWM and be over the age of 18. Exclusion criteria were those with expired student memberships and anyone under the age of 18 years old.

Procedure

Ethics approval for this study was sought and obtained from the Institutional Review Board at Youngstown State University (Protocol 183-19). The survey was administered electronically using the Alchemer online survey platform (Alchemer LLC, Louisville, CO). Data were collected via a cross-sectional survey emailed to eligible participants which was open from April 2019 through June 2019. Participants received reminder emails to complete the survey in week 2 and week 4. Informed consent was provided in the body of the email and at the beginning of the survey, once it was opened. Participants were informed that participation was voluntary and that the survey was designed to be completed anonymously; however, participants were offered an opportunity to enter a raffle after completing the survey for a chance to win one of two $25 gift cards by providing an optional nickname and contact phone number. The collection of nickname and phone number was not collected separately and was therefore associated with their survey responses.

Questionnaire

Item generation for the questionnaire (Table 1) was developed based on discussions among professional and student ACEWM members. The discussions revealed these ACEWM professional and student members' vision for student members, the perception of the value being received by student members, and opinions on how the ACEWM could improve the student members' experience. Prior to administering the questionnaire, both investigators confirmed its accessibility, usability, and technical functionality. The survey questionnaire was comprised of five demographic items (omitted in Table 1) and 10 survey questions for which students reported their level of agreement on a 5-point Likert scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree). The participants were able to review and change their answers by toggling between pages prior to submission. To ensure the completeness of each submission, participants were unable to submit the survey unless all questions were answered. An error message, appearing as a highlighted red asterisk, would direct participants back to each unanswered question. To prevent unwanted individuals from completing the survey, the survey was only accessible through an individual link assigned to the e-mail address on file for each SSIG member.

Data Analysis

Microsoft Excel for Mac version 16.58 was used for the data analysis. Descriptive statistics were used to describe the demographic characteristics of the participants and univariate analysis was used to describe the variable distribution for each of the 10 survey items.

3. Results

Figure 1 represents the response rate of 31.3% (56/179) and is broken down by the geographic location of each participant's physical therapy program or physical therapist assistant program. Of the complete responses, 23.2% were males (n=13) and 76.8% were females (n=43). Participants in the second year of their physical therapy education had the largest response rate at 42.9% (n=24), followed by those in their third year (n=18), with a response rate of 32.1%. First-year participants (n=14) responded the least (25.0%). 57.1% of the participants (n=32) were also members of their state chapter's SSIG. Considering eight participants were from a state that did not have a SSIG, the percentage was adjusted to 66.7%. It is notable that participants from New York State (n=17) made up 30.4% of total respondents, the highest compared to those from all other states. Most participants (n=43, 76.8%) were also a member of other APTA sections.

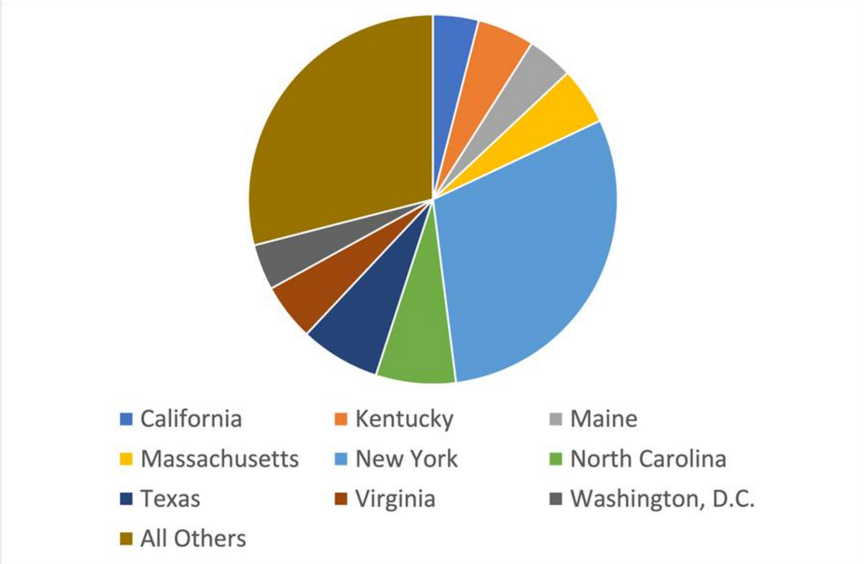

Figure 1. Distribution of Survey Responses by Geographic Location in the United States. The data represents a response rate of 31.3% (56/179) for all electronically administered surveys.

The percentages of responses to each of the 10 Likert items are illustrated in Figure 2. Overall, most participants (71.2%) were aware that the ACEWM offered a SSIG at no additional cost and felt that a SSIG was valuable to them as a student member (71.2%). Most participants acknowledged that they would gain valuable skills, knowledge, and professional opportunities by being a member of the SSIG (85.8%). Participants agreed or strongly agreed that it is important to interact with other students sharing similar career interests (93.3%). Participants identified networking with expert clinicians with common clinical interests to theirs to be of value (98.3%). Most participants were in favor of the SSIG offering programs on electrophysiology (71.2%), wound management (89.8%), biophysical agents (69.5%), and diagnostic ultrasound (69.5%) to supplement their DPT curriculum.

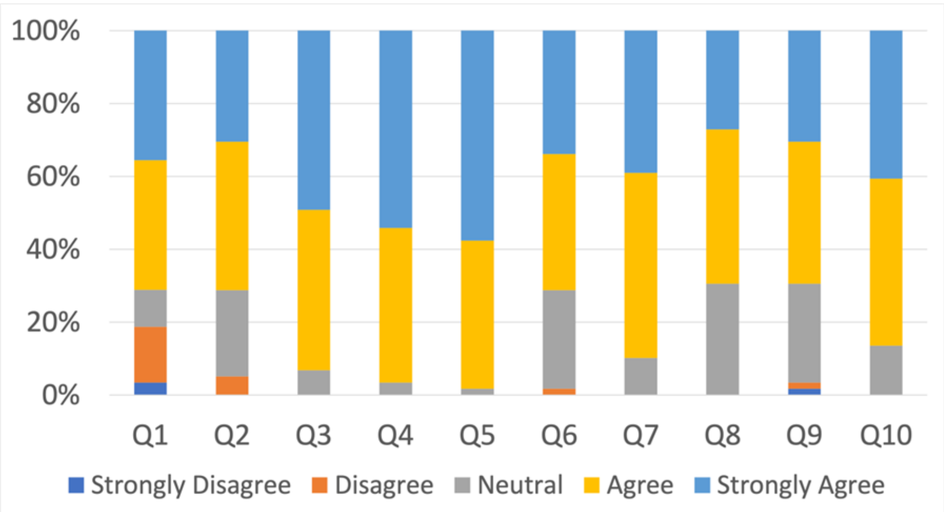

Figure 2. Summary of Responses to 10-Item Survey Questionnaire. Participants reported their level of agreement on a 5-point Likert scale to close-ended questions presented in Table 1. The data represents a response rate of 31.3% (56/179) for all electronically administered surveys.

4. Discussion

The APTA consists of 51 state chapters and 18 specialty sections – the ACEWM being one of these specialty sections. Within the ACEWM, there are multiple SIGs, including the SSIG. This was the first study investigating student member attitudes, perceptions, and expectations of a SSIG, specifically the ACEWM of the APTA. A thorough literature search using PubMed, WorldCat.org, Academic Search Complete, Research Library, and EBSCOhost was performed. The initial search for full text, peer reviewed publications from 2010-2022 using the keyword 'physical therapy student special interest group' populated 295 results. To narrow the results, publications containing 'physical therapy student special interest group' in both the title and abstract were searched. This reduced the results to a single publication directly related to physical therapy.[5]

Smith et al.[5] described a physical therapy program's student and faculty participation in weekly SSIG meetings. This specific program developed an orthopedic SSIG and a neurologic SSIG to promote discussion beyond the classroom setting. The purpose of their study was to identify participants' perceptions of how the two SSIGs impact their clinical decision-making skills, knowledge, and clinical skills. At least 95% of the participants (n = 181) surveyed in this study agreed that meeting with the SSIG's members was valuable and would help develop them into stronger physical therapists. Additionally, the participants reported a belief that the presence of interdisciplinary healthcare providers would increase the value of their participation in the SSIG meetings. The attitudes and expectations of the SSIGs were not investigated in their qualitative study. Our data are consistent with their findings that participants have positive perceptions towards a SSIG. Further research to clearly define students' attitudes, perceptions, and beliefs on SSIG participation and membership is needed.

While only one publication[5] exists on physical therapy SSIGs, there were studies on SSIGs offered to medical students.[9,10] O'Keefe[9] investigated medical students' perceptions of an emergency medicine SIG and the impact it had on their choice of medical specialty. In a survey administered to 67 medical students, 54% of participants indicated that the emergency medicine SIG had an impact on the specialty they chose and 97% would recommend interest groups to first-year medical students for the value of networking. Bhatnagar et al.[10] examined the impact of mentorship on fourth-year osteopathic medical students' decisions when choosing clinical rotations, residency programs, area of practice, research interests, and career trajectory. This study indicated that medical students have a desire for mentorship and feel that having a mentor early on in their education made it easier to choose a specialty area of practice. Our data, again, are consistent with the literature that students have a desire for professional development and networking for mentorship.

Outside of the healthcare industry, the American Society for Indexing (ASI)[11] administered a survey to its SIG members looking to identify current areas of value, areas for improvement, and ways to better serve ASI members. Students reported online discussions and webinars to be areas they perceived as having the most value.[11] We did not collect data about online discussions and webinars in our study, however, it would appear beneficial to implement these strategies for professional development in the future. Our data indicated that participants believed it was important to communicate with students and expert clinicians sharing similar career interests. The SSIG may consider facilitating a structured, online discussion board moderated by an expert clinician to promote student interaction with one another. Different topics for discussion may include the residency application process, a review of test questions in preparation for the physical therapy licensure exam, or a monthly case report with a discussion on clinical reasoning for various treatment strategies. Additionally, the SSIG may consider the development of a mentorship program where a student is paired with a member clinician. Student mentorship has been recognized as having a large impact on personal development, professional development, career guidance, choice of medical specialty, and career progression in the medical profession; however, there is limited detail in the literature outlining the most effective structure for mentorship (e.g., formal vs. informal, group setting vs. one-on-one) and limited insight into how to best pair a mentor with a mentee (e.g., assignment vs. self-identified).[12] The SSIG may need to conduct further research to identify the most appropriate type of mentorship for this group.

Our data indicated that most participants were in favor of the SSIG offering continuing education to supplement their DPT curriculum. Similarly, McCarthy et al. [13] described medical student involvement in a SSIG as a way to access affordable continuing education. Linehan et al.[14] described a Student Radiology Interest Group's development of an extra-curricular skills workshop devoted to diagnostic ultrasound as a supplement to their education. The radiology students reported that topics covered in this specialized workshop were critical for their future careers because they did not receive enough training in their current curriculum.[14] Therefore, another way the SSIG could offer supplemental education to its members is through live, pre-recorded, or interactive workshops outside of the curriculum. For example, one such workshop could focus on wound debridement, using a navel orange, to practice manual hand dexterity skills. This simulated environment is a safe way to practice these skills without direct patient care and allows students to participate voluntarily. Another workshop topic could be on the various types of ultrasonography that fall within the physical therapy scope of practice. Whittaker et al.[15] stated that there was no internationally accepted curriculum for training physical therapists in the use of diagnostic ultrasound (DUS) and that appropriate use of DUS is not part of an entry-level physical therapy program. Many ACEWM members are experts in the use of ultrasonography and could provide value in sharing their experience and clinical knowledge with students. Providing informal and formal webinars and education sessions could serve as helpful educational tools for students. An added benefit of recording webinars is that students may revisit the content at any time, allowing time to digest the material.[16]

Likewise, the literature suggests that SSIG members may benefit from panel discussions with senior members of the professional association. The Student Oncology Society (SOS) within the Boston University Chobanian & Avedisian School of medicine hosts an annual panel of physicians specializing in various oncology specialists.[17] The physicians discuss their career path and describe their typical workday along with answering questions from students. After one panel discussion, researchers distributed a survey to the 35 student attendees to identify the impact the SOS had on student interest in oncology. Of the 23 completed survey questionnaires, 100% of students reported that they found the discussion panels "valuable" or "somewhat valuable." There were 37% of participants who believed a panel discussion on the various career paths within oncology would be beneficial to stimulate early career interest and improve awareness of the oncology field of medicine.[17] A follow-up survey was administered to all 32 former student leaders of the SOS to identify how their participation informed their career choice.[18] Of the 26 returned surveys, all respondents indicated that having a SOS sponsored by faculty was "moderately important", "very important" or "extremely important". Out of all the participants, 73.1% indicated that they eventually pursued an oncology-related specialty. The most important factor for choosing their career was reported to be having a mentor.[18] These studies support the value of a career panel and may be used as a framework for the ACEWM SSIG to develop similar discussions with the various specialties ACEWM members represent.

Our data revealed that 28.8% of ACEWM student members were unaware that they had access to a SSIG at no additional cost to their membership. This may indicate the need for distinction between a general ACEWM student membership and a SSIG membership, as well as better marketing strategies on behalf of the SSIG. One major benefit of SSIG membership is the opportunity to participate in the student-elected Council of Officers. As most students acknowledged that they would gain valuable skills, knowledge, and professional opportunities as a member, the SSIG could highlight various career and professional development skills obtained from holding an elected officer position. Participation in student government teaches students to be proactive, autonomous, and responsible. It also requires efficient time management skills as participation is voluntary and separate from their schoolwork.[19] Students who hold an elected position can learn life skills of managing individuals and small teams, creating objectives along with methods to achieve them, and improving self-confidence as they recognize their role in the greater operation of their organization. The ACEWM may promote the benefits of holding a leadership position early on in a student's career as a direct benefit of SSIG participation.

5. Limitations

One limitation of this study was the use of convenience sampling because it reduced the generalizability of the findings. We were unable to expand the sample size to include all APTA student members as their contact information is private and requires a monetary fee to gain access. In future studies, it would be advantageous to pay the fee and have access to a larger and more diverse sample.

Another limitation was the use of an online questionnaire as our data collection method. A questionnaire limits the ability for following up on questions and does not allow for clarification of poorly written questions. For instance, question four of our survey asked participants about their expectations of the SSIG to promote a culture of clinical excellence. Clinical excellence is an ambiguous term, and it cannot be expected that all participants define it the same way. This may lead to poor interpretation of the question and can cause the data to be unreliable.[20] Future studies may be conducted to characterize the meaning of clinical excellence to all ACEWM members.

Finally, the survey questionnaire was developed by the investigators based on their discussions and perceptions of the student membership presence within the ACEWM and was not tested for validity and reliability. The survey questionnaire was limited to 10 questions to increase the likelihood of completion rate, as evidence has shown that participants receiving a shorter questionnaire are more likely to respond; however, more questions could have been asked.[21]

6. Conclusion

The results of this study may be used to guide the SSIG's future strategic planning for the development of quality content, improvement of the SSIG's perceived value, and delivery of meaningful benefits to SSIG members. There are various methods for meeting the needs of each SSIG member such as implementing a discussion board on the SSIG website, developing a mentorship program, offering live or recorded webinars on special topics, and hosting a panel discussion featuring a provider from each of the specialty areas embodied by the ACEWM. The SSIG can highlight the life skills gained from holding a leadership position on a student-governed council as another added benefit to SSIG membership. A position on the Council of Officers may be a catalyst for continued professional involvement and leadership. The findings of this study can be used to prioritize benefits offered not only to ACEWM SSIG members but to all APTA components as well as other health professional organizations. Further research is necessary to refine the specific type of content and offerings the SSIG should develop.

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Table 1. Blank ACEWM Student SIG Survey Questionnaire.

Q1. I am aware that we have a student SIG within the ACEWM and there is no additional cost to join in.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q2. The student SIG is valuable to me as a student member.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q3. It is important to interact with other students with a similar career interest as mine.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q4. The student SIG should promote a culture of clinical excellence.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q5. It is important to network with expert clinicians with a similar career interest as mine.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q6. The student SIG should offer more educational programs on electrophysiology in the practice of physical therapy to supplement my DPT curriculum.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q7. The student SIG should offer more educational programs on wound management in the practice of physical therapy to supplement my DPT curriculum.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q8. The student SIG should offer more educational programs on biophysical agents in the	1. ☐ Strongly disagree 2. ☐ Disagree

practice of physical therapy to supplement my DPT curriculum.	3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q9. The student SIG should offer more educational programs on diagnostic ultrasound in the practice of physical therapy to supplement my DPT curriculum.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree
Q10. I will gain valuable skills, knowledge, and professional opportunities by being a member of the student SIG.	1. ☐ Strongly disagree 2. ☐ Disagree 3. ☐ Neither Agree nor Disagree 4. ☐ Agree 5. ☐ Strongly Agree

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Case Series

COVID-19 Vaccination Related Lymphadenopathy as a Cause of Acute Shoulder Pain: A Report of Two Patients

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Abstract

Introduction: Physical therapists have utilized ultrasound imaging for over three decades for cross sectional muscle thickness, age-related musculoskeletal changes, response of muscle to interventions, and for biofeedback. More recently, physical therapists have started to incorporate point of care ultrasound as a diagnostic tool for a variety of neuromusculoskeletal conditions including fractures, schwannomas, entrapment of neurovascular structures, and muscle disease. The purpose of this case report is to describe the evaluation and treatment of two patients with shoulder pain that was thought to be musculoskeletal in nature who were subsequently diagnosed with COVID-19 vaccination-related lymphadenopathy and also bring attention to lymphadenopathy as a potential side effect of the COVID-19 vaccination.

Case Description: The first patient case was a 26-year-old male with a chief complaint of right shoulder pain and heaviness who was referred for ultrasound imaging by his physician for a suspected rotator cuff tear. He reported that his symptoms started 2 days prior after playing basketball. The second patient case was a 33-year-old male with a chief complaint of left shoulder pain that was insidious in onset 5 days prior who was referred for ultrasound imaging by his physician. For both patients, the physical examination demonstrated full pain-free range of motion and normal muscle strength for their involved shoulders. Point of care ultrasound imaging performed by the physical therapist was also negative for tendon or bursa abnormalities for the involved shoulder in both patients. Upon further questioning, the first patient stated that he received his first of two COVID-19 vaccinations three days prior in his right deltoid region and the second patient stated that he received his first of two COVID-19 vaccinations six days prior in his left deltoid region. While both patients were afebrile, they did report a recent onset of fatigue after their vaccination. Their past medical histories were unremarkable. Ultrasound imaging of the axillary region for both patients revealed swollen lymph nodes with hilar vascularity on Doppler ultrasound imaging; the axillary nodes were also tender to palpation. Other lymph nodes in the same axillary region as well as the contralateral axillary region did not show any swelling for both patients.

Outcomes: Both patients were referred to their physicians and both were diagnosed with COVID-19 vaccination-related lymphadenopathy. Following the second of two COVID-19 vaccinations, both patients experienced fatigue, malaise, and fever that started about 8 to 12 hours after the second vaccination and resolved within 24 hours.

Discussion: Lymphadenopathy is a potential side effect of COVID-19 vaccination. This report suggests that this condition may manifest as shoulder pain that mimics musculoskeletal pathology; thus, it is important for physical therapists to be aware of this important side effect. If lymphadenopathy is suspected, appropriate screening and medical referral are necessary.

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1. Introduction

In response to the COVID-19 pandemic that claimed the lives of more than 6 million people worldwide, three COVID-19 vaccines were developed and authorized by the Food and Drug Administration for emergency use.[1,2] Two of these vaccines, Pfizer and Moderna, demonstrated effectiveness rates of preventing symptomatic COVID and hospitalization of 88% and 93%, respectively. Despite the benefits of vaccination, adverse effects to the vaccines have been reported in 64% of individuals after 1 dose with adverse event rates increasing to 80% after both doses.[3] The most common adverse reactions to the vaccines, which are mild in nature and resolve within a few days, include the following: local injection site pain, fever, chills, myalgia, headache, and fatigue. Severe complications have been reported in 0.2-1.1% of cases including thrombocytopenia and allergic reactions/anaphylaxis.

One interesting adverse reaction noted following vaccination is vaccine associated reactive lymphadenopathy (VARL) which is a typical immune response but may present a diagnostic challenge during medical screening. This is of utmost clinical importance in individuals who may be seen with a history of malignancy as unilateral axillary lymphadenopathy (UAL) is frequently seen in patients with breast cancer. Determining the cause of UAL as benign or malignant is crucial following its presentation on multiple imaging studies including ultrasound, positron emission tomography, magnetic resonance imaging, mammography, and computed tomography.[8] Unilateral axillary lymphadenopathy may be seen on typical imaging for other conditions or during oncologic follow-up exams and present a diagnostic dilemma.

Physical therapists have utilized ultrasound imaging for over three decades for cross sectional muscle thickness, age-related musculoskeletal changes, response of muscle to intervention, and for biofeedback. More recently, physical therapists have started to incorporate point of care ultrasound as a diagnostic tool for a variety of neuromusculoskeletal conditions including fractures, schwannomas, entrapment of neurovascular structures, and muscle disease. Neuromusculoskeletal ultrasound is used as an extension of the physical examination to assist in the diagnosis and management of peripheral nerve and orthopedic conditions. Included in the roles of the physical therapist is medical screening to ensure symptoms are neuromusculoskeletal in nature and not a more serious medical condition that requires referral to another specialty. The purpose of this case report is to describe the evaluation and treatment of two patients with shoulder pain that was thought to be musculoskeletal in nature who were subsequently diagnosed with COVID-19 vaccination related lymphadenopathy. This case report was prepared following the CARE Guidelines.[12]

2. Patient Information, Clinical Findings, and Diagnostic Assessment

Case 1

The first patient was a 26-year-old male with a chief complaint of right shoulder pain and heaviness who was referred to a physical therapist for ultrasound imaging by his physician for a suspected rotator cuff tear. He reported symptoms started 2 days prior after playing basketball. Past medical and surgical history were unremarkable, and the patient was afebrile. The physical examination demonstrated full pain free range of motion and normal muscle strength of the right shoulder. Ultrasound imaging was negative for tendon, bursal, or joint abnormalities. Upon further questioning, the patient had received his first dose of the COVID-19 vaccination three days prior in his right deltoid region and was experiencing fatigue since the injection. Ultrasound imaging of the axillary region revealed a singular swollen lymph node with hilar vascularity (Figure 1 & Figure 2). The axillary nodes were also tender to palpation. Other lymph nodes in the same axillary region as well as the contralateral axillary region did not show any abnormalities. The patient was referred to their physician and subsequently diagnosed with COVID-19 vaccination-related lymphadenopathy. The patient was advised by his physician to follow up after one week if the symptoms persisted. The patient did not show up for a follow up.

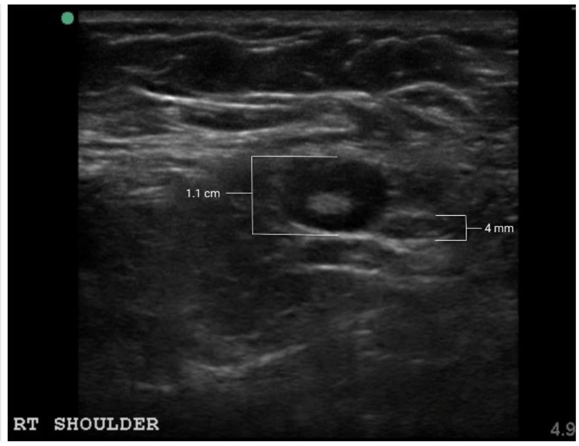

Figure 1 - Case 1. Diagnostic ultrasound assessment of the right axillary region revealing an anechoic thickened cortex ring around the hyperechoic hilum indicating a swollen lymph node which measured 1.1 cm. Note the normal appearance of the other lymph node which measured 4 mm.

Figure 2 – Case 1. Color Doppler ultrasound assessment of the right axillary region revealing positive color Doppler findings of the swollen lymph node.

Case 2

The second patient was a 33-year-old male with a chief complaint of insidious left shoulder pain that started 5 days prior. This patient was referred to a physical therapist for ultrasound imaging by his physician. Past medical and surgical history were unremarkable, and the patient was afebrile. The physical examination demonstrated full pain free range of motion and normal muscle strength of the left shoulder. Ultrasound imaging was negative for tendon or bursa abnormalities. Upon further questioning, the patient had received his first dose of the COVID-19 vaccination six days prior in his left deltoid region and was experiencing fatigue since the injection. Similar to the first case, ultrasound imaging of the axillary region revealed a singular swollen lymph node with hilar vascularity (Figure 3 & Figure 4). The axillary nodes were also tender to palpation. Other lymph nodes in the same axillary region as well as the contralateral axillary region did not show any abnormalities. The patient, much like the first patient, was referred to their physician and subsequently diagnosed with COVID-19 vaccination-related lymphadenopathy. The patient consulted the physician after 3 weeks for a regular follow up. The symptoms were resolved with no complaints of any shoulder pain or discomfort. A follow up ultrasound scan of the lymph node showed the same findings as previously noted with absent tender points using sono-palpation. The physician did not recommend a follow up visit.

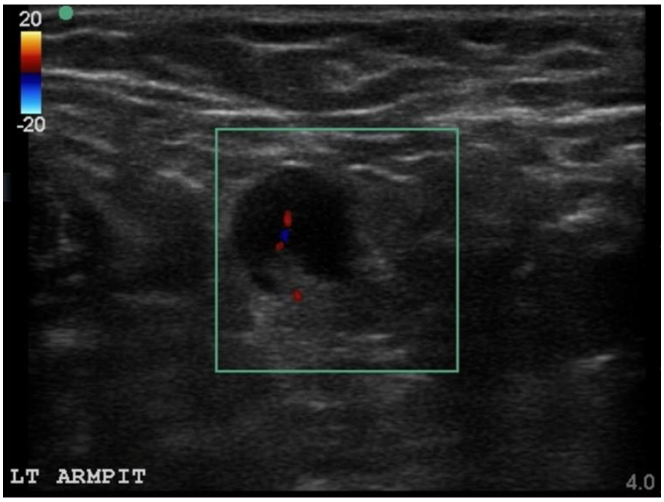

Figure 3 – Case 2. Color Doppler ultrasound assessment of the left axillary region revealing positive color Doppler findings of the swollen lymph node.

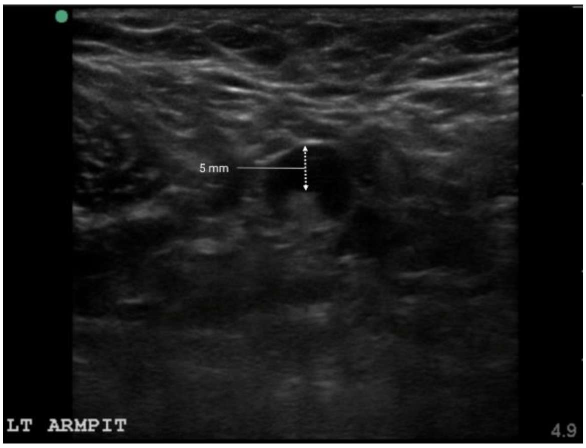

Figure 4 – Case 2. Diagnostic ultrasound assessment of the left axillary region revealing an anechoic thickened cortex ring measuring 5 mm around the hyperechoic hilum.

3. Discussion

The patients described in this report were referred to a physical therapist for ultrasound imaging for suspected orthopedic conditions of the involved regions. Both patients were subsequently sent back to the referring physician due to signs of lymphadenopathy on routine ultrasound imaging.

Vaccine associated reactive lymphadenopathy (VARL) is considered a mild adverse reaction to the COVID-19 mRNA vaccines, which depend on the migration of antigen-presenting cells to regional lymph nodes to elicit a cellular (T-Cell) and humoral (B-Cell) immune response.[4] Additionally, mRNA vaccines elicit a more robust B-Cell proliferation in the lymph node, which increases the incidence of UAL.[4] The reported duration of VARL is typically 10 days with positron emission tomography and computed tomography scans demonstrating trace duration of up to 32 days.[5,6] As previously mentioned, it is reasonable to expect an increased frequency of UAL on imaging after vaccination which may persist for 1 month after the dose.

A normal lymph node appearance on ultrasound is of oval or lobulated shape with a well-defined margin. The node has a hyperechoic representation of the fatty hilum and a thin uniform hypoechoic cortex surrounding the hilum. A hypoechoic cortex measuring 3 mm or less is considered normal.[11] Morphologic criteria, such as cortical thickening, hilar effacement and non-hilar cortical blood flow, are more important than size criteria in the identification of metastases.[10]

Of interest, sonographic evaluation of the axillary lymph nodes in both patients demonstrated cortical thickening as well as positive vascularity patterns. Hilar vascularity refers to color doppler signals originating symmetrically from the nodal hilum of the lymph node and is typically seen in benign or reactive lymph nodes as seen in lymphadenopathy. Evaluation of lymph node vascularization is an important tool which allows the sonographer to classify vascular patterns as either normal/reactive or consistent with metastatic involvement. The first patient's compromised lymph node measurement was 1.1 cm versus 4 mm for a normal adjacent lymph node. The second patient's compromised lymph node had a cortical thickness that was measured at approximately 5 mm.

Several guidelines have been developed to direct patient care when working with patients with UAL. The Society of Breast Imaging has proposed guidelines especially when working with patients with recent or past breast cancer or malignancy.[7] These guidelines have been endorsed by several international organizations including the Canadian Society of Breast Imaging.[8] The most comprehensive algorithm to assist with guiding management of UAL across specialty settings, inclusive of the oncology specialty, was proposed and published by Lehman et al.[9] In the proposed management plan, patients should be classified into one of the following three categories: 1) as an isolated finding on imaging, 2) in conjunction with another finding on imaging, and 3) in a patient undergoing cancer staging and/or treatment.

The guidelines suggest if UAL is noted less than 6 weeks after last vaccination in an individual with no other additional findings, this should be treated as a benign finding and no further imaging should be performed. As seen with the two patients mentioned in this case report, this was the only finding on clinical or ultrasound examination. As this can be a clinical finding in serious disease, both patients were promptly referred to the provider for medical examination, diagnosis, and management. It is recommended, however, that axillary ultrasonography should be performed after 6 weeks of vaccination if clinical concern still exists. Patients who fit into categories 2 and 3 as mentioned above are encouraged to undergo prompt recommended imaging. Management of categories 2 and 3 is tailored to the specific patient and is beyond the scope of this report but the decision making and referral steps for the physical therapist performing ultrasound imaging in patients with suspicious lymphadenopathy are the same. The role of the physical therapist who performs ultrasound imaging is the following: 1) perform a clinical examination, 2) perform an ultrasound imaging examination as an extension of the clinical exam, 3) document relevant and potential incidental findings, and 4) refer the patient back to the referring provider.

4. Conclusion

To further clarify the clinical picture in patients undergoing ultrasound imaging who may demonstrate signs of lymphadenopathy, we recommend documenting at a minimum, the dates of vaccination administration and laterality of each injection. Vaccination brand should also be recorded as the rate of VARL is higher with certain vaccine manufacturers. This documented information may help paint a clearer picture of the patient's case and provide crucial information to the referring physician when they are determining the medical management of the patient.

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