The Use of the Mulligan Concept in the Treatment of Patellofemoral Pain Syndrome in Dancers: A Dissertation of Clinical Practice Improvement

A Dissertation
Presented in Partial Fulfillment of the Requirements for the
Degree of Doctor of Athletic Training
with a
Major in Athletic Training
in the
College of Graduate Studies
University of Idaho
by

Ryan Krzyzanowicz

Major Professor: Alan Nasypany, Ed.D.
Committee Members: James May, D.A.T.; Peter Hoyt, Ph.D.; Frank Gargano, D.P.T.
Department Administrator: Phillip W. Scruggs, Ph.D.

January 2016

Authorization to Submit Dissertation

This dissertation of Ryan Krzyzanowicz, submitted for the degree of Doctor of Athletic Training and titled "The Use of the Mulligan Concept in the Treatment of Patellofemoral Pain Syndrome in Dancers: A Dissertation of Clinical Practice Improvement," has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor: _____Date_____
Alan M. Nasypany, Ed.D.

Committee Members: _____Date_____
James May, D.A.T.

_____Date_____
Peter L. Hoyt, Ph.D.

_____Date_____
Frank Gargano, D.P.T.

Department Administrator: _____Date_____
Phillip Scruggs, Ph.D.

Abstract

A dissertation of clinical practice improvement (DoCPI) includes use of an action research philosophy designed to improve clinical practice and documentation of progress in an area of advanced clinical practice. Accordingly, this DoCPI illustrates clinical skill and scholarly practice development through evaluation and treatment of dance related injuries with a targeted use of the Mulligan Concept, and contains critical reflection and elucidation of philosophies for clinical practice and for teaching. A Plan of Advanced Practice (PoAP) was developed to highlight specific steps needed to develop into an advanced practitioner and a strong educator. An action research strategy was used to clinically assess application of the Mulligan Concept for evaluation and treatment of patellofemoral pain in recreational dancers. Research outcomes were disseminated through conference presentations and, for initial research on use of the Mulligan Concept to treat sacroiliac joint pain in dancers, through publication of a case series. This DoCPI illustrates evidence of scholarly development and progress toward advanced clinical practice in athletic training.

Acknowledgements

Many individuals have assisted in many aspects for the completion of this research project. I wish to extend my appreciation and thanks to the following individuals:

Dr. Alan Nasypany, my committee chair, for his support, knowledge, and expertise. I am grateful for his vision of development of an advanced practice degree in athletic training. His mentorship will have long-lasting effects on how I view athletic training.

Dr. Jeff Seegmiller, faculty mentor, for his support, knowledge, and research capabilities. His insistence on critical thinking or "stare at the fish" truly was appreciated. Without his mentorship, I could not have reached my potential.

Dr. James May, committee member, for his mentorship through the DAT program and the process of writing the dissertation. I am lucky to have him as a friend, a colleague and professional role model.

Dr. Peter Hoyt, committee member, for his mentorship not only on this research project, but also in my development as a faculty member. His support and understanding promoted my growth as an educator and clinician.

Dr. Frank Gargano, committee member, for his mentorship and expertise on the Mulligan Concept. I am a better clinician because of his knowledge and guidance in my area of advanced practice.

Sarah Krzyzanowicz, my wife, for her editing abilities, love, support and confidence in me through this journey. I could not have completed this process without her and I am eternally grateful that she is by my side.

Dr. Anne Goodwin, editor, fellow faculty member and friend, for her editorial support and guidance throughout the writing process.

Maria LaValley, Ron Shewcraft, Dr. Jerry Smosky, and Dr. Ann Billetz, the support team for the Athletic Training Program at MCLA. Their support and assistance throughout this journey has been much appreciated.

Dedication

To my wife Sarah, Mom and Dad (Mary Jane and Jim), my siblings (Lori and Danny), and Emma.

You have supported me in different ways, but have all made an impact on the person and professional that I have become. I am grateful to each of you.

Table of Contents

List of Figures

List of Tables

Chapter 1: Narrative Summary

The innovative Doctor of Athletic Training (DAT) program at the University of Idaho allows practicing athletic trainers (ATs) to pursue a post professional doctorate with a focus on clinical practice. Doctor of Athletic Training students are encouraged to apply new techniques, foundational information and evidence from the literature at a clinical residency site with an attending clinician (Nasypany, Seegmiller, & Baker, 2013). The capstone project in the DAT program is the Dissertation of Clinical Practice Improvement (DoCPI). The professional practice dissertation describes evolution of philosophies, clinical practice skills, and research capabilities developed through the DAT program.

Structured with a focus on improving clinical practice, the DAT program fosters development of knowledge, research strategies, and clinical skills required by advanced practitioners in an athletic training discipline. The term "advanced practice athletic trainer" is relatively new. At the Athletic Training Educators' Conference in Dallas, TX, Nasypany, Seegmiller, and Baker (2013, Table 1) defined an advanced practice athletic trainer as:

> …an athletic trainer who has developed a focused area of clinical practice through the attainment of knowledge and skills both academically and through critical reflection of their patient outcomes. Advanced practice AT clinicians have mastered general athletic training practice and accumulated depth of practice in a more limited area of clinical practice (e.g., treatment and rehabilitation of injuries).

An advanced scholarly practitioner has at least 5-10 years of experience, understands theories in depth and breadth, and builds expertise in a focused area of clinical practice (Nasypany et al., 2013). In the DAT program, the journey to advanced practice involves improvement of basic science knowledge through course work, action research conducted as

part of the clinical research project and translational research conducted as part of clinical practice improvement. An advanced practitioner must be an expert in the current body of knowledge related to their focus area and have the ability to produce clinical outcomes that exceed expectations or improve on those obtained by most practitioners in this focus area (Nasypany et al., 2013).

Action research is "an approach employed by practitioners for improving practice as part of a process of change. The research is context-bound and participative" (Koshy, Koshy, & Waterman, 2011). The key word in the definition of action research is "participative". Participatory research involves a community or a local population (e.g., patient population) and is easily translated from bench to bedside (Cornwall & Jewkes, 1995). Action research also requires the clinician to critically reflect upon the data collected, a process the DAT program references as "scholarly reflection" or "reflective practice" (Nasypany et al., 2013). In response to this reflection, the clinician may change components of the study and/or evolve the study based upon the findings.

Translational research involves applying discoveries generated during research in the laboratory to human subjects in clinical practice, as well as sending questions from the field back to the laboratory to improve understanding (Rubio et al., 2010). Both action research and translation research are critical for improving clinical practice, and since students in the DAT program are practicing clinicians, this work can inform and be informed by clinical experiences. Advanced practitioners use evidence-based medicine to guide their clinical practice, collect practice-based evidence and add to the current literature through dissemination of scholarly products. Practice-based evidence is high-quality scientific evidence that is defined, refined, and implemented in a real world setting (Pincus & Sokka,

2006). In a clinical environment, practice-based evidence may be accomplished by using an a priori design in daily clinical practice, which requires defining the parameters (e.g., patient population, intervention, outcome measures) of the study before collecting data (Hurley, Denegar, & Hertel, 2011).

Scholarly reflection is critical in developing and evolving an action research plan and in translating research findings into clinical practice. The use of scholarly reflection or reflective practice is common in healthcare and allows the clinician to dissect and learn from his or her clinical practice (Koshy et al., 2011). Reflective practice is cyclical in nature and can help clinicians identify weaknesses within their knowledge base, clinical practice, and research efforts (Koshy et al., 2011).

Scholarly reflection allows clinicians to focus on specific areas of patient care. Through reflection on my clinical practice, I identified that the majority of patients complain of patellofemoral pain, and that further research into assessment strategies for knee pain could be useful. After consideration of published literature on the subject, I decided to enhance my skills in functional movement assessment. I developed a plan for improvement, which included increasing my knowledge through the information provided in the Functional Movement Systems conference and I applied this new knowledge to my clinical practice, implementing the Selective Functional Movement Assessment (SFMA) to help assess dysfunctional movement patterns. As my ability to better assess movement dysfunctions improved through patient classification, my patient care and patient outcomes also improved.

A critical component of the DAT training is development of a Plan of Advanced Practice (PoAP). In creating a PoAP, the DAT student identifies personal strengths and weaknesses to develop a structured and measureable plan to progress toward advanced

practitioner status. Reflection and self-evaluation allow clinicians to identify areas of improvement including: clinical practice, basic scientific knowledge, and research capabilities. The PoAP is unique to each DAT student, addressing the specific weaknesses identified through self-evaluation. Ideally, the PoAP is a well-developed and well-constructed plan for improving basic scientific knowledge and sound foundational knowledge (e.g., literature review), clinical practice, and a focused area of advanced practice, including action research. For example, a goal in my PoAP, described in Chapter 2, was to improve collection and documentation of patient outcomes using the Mulligan Concept.

Chapter 3 highlights scholarly goals accomplished through my DAT training including improving my knowledge base with regards to dance injuries and interventions, advancing my clinical practice through the use of the Mulligan Concept and other techniques learned through the DAT program. Dissemination of knowledge was accomplished through conference presentations and peer-reviewed publications. A highlight of my scholarly progress was publication of a case series describing treatment of dancers with sacroiliac joint pain using the Mulligan Concept. A case series illustrates practical meaning for clinicians, guiding improvements in clinical practice, and can be used by bench researchers as a basis for further studies, including randomized controlled trails (Westfall, Mold, & Fagnan, 2007). My advances in clinical knowledge, translation of new knowledge into improvements in clinical practice, and experiences in disseminating scholarly analysis were critical steps in my development into a scholarly practitioner.

The dissertation of clinical practice improvement (DoCPI) is the culmination of two years of didactic course work and hands-on skill development involving scholarly reflection in an area of advanced practice. My DoCPI is evidence that I am on the path to becoming a

scholarly practitioner with an area of advanced practice in assessment and rehabilitation related to a dance specific population utilizing manual therapy. A manuscript titled "Patient Outcomes Utilizing the Selective Functional Movement Assessment and Mulligan Mobilizations with Movement on Recreational Dancers with Sacroiliac Joint Pain: A Case Series" describes patient outcomes and is included as Chapter 4.

For my action research project, I used the Mulligan Concept as an intervention to treat patients with patellofemoral pain syndrome. I treated five consecutive patients with the Mulligan Concept, documented the outcomes, analyzed the results, and reflected on the findings, as outlined in Chapter 5. The study provided a basis for my future work in athletic training research and has informed my clinical practice, leading to improvement in strategies for assessing patients, treating patellofemoral pain and documenting outcomes.

Through the reflections, literature review and action research presented in this DoCPI, I provide evidence that I have made improvements towards becoming an advanced practitioner of athletic training in the Mulligan Concept. A goal of the DAT program is to produce scholarly advanced practitioners who regularly contribute to the body of knowledge in an area of expertise. Dissemination of knowledge, clinical practice reflection, and changes to clinical practice are continual processes for the advanced practitioner, and I will continue to work in these domains.

References

Cornwall, A., & Jewkes, R. (1995). What is Participatory Research? *Soc Sci Med, 41*(12), 1667-1676.

Hurley, W., Denegar, C., & Hertel, J. (2011). *Research Methods A Framework for Evidence-Based Clinical Practice* (1st ed.). Baltimore, MD: Lippincott, Williams & Wilkins.

Koshy, E., Koshy, V., & Waterman, H. (2011). *Action Research in Healthcare*. Thousand Oaks, California: SAGE Publications Inc.

Nasypany, A., Seegmiller, J., & Baker, R. (2013). *A Model for Developing Scholarly Advanced Practice Athletic Trainers in Post-Professional Education Programs*. Paper presented at the 2013 Atheltic Trainers' Educators Conference, Dallas, TX.

Pincus, T., & Sokka, T. (2006). Evidence-based practice and practice-based evidence. *Nat Clin Pract Rheumatol, 2*(3), 114-115.

Rubio, D., Schoenbaum, E., Lee, L., Schteingart, D., Marantz, P., Anderson, K., Esposito, K. (2010). Defining translational research: implications for training. *Academic Medicine: Journal of The Association of American Medical Colleges, 85*(3), 470-475.

Westfall, J., Mold, J., & Fagnan, L. (2007). Practice-Based Research- "Blue Highways" on the NIH Roadmap. *Journal of American Medical Association, 297*(4), 403-406.

Chapter 2: Plan of Advanced Practice: Developed April 8, 2015

A critical component of my DAT progression involved developing a Plan of Advanced Practice (PoAP). My PoAP, which has been influenced by my educational and clinical experiences, incorporated concrete plans for improvement in terms of pedagogy and clinical practice. My journey to advanced practice in treatment and assessment of dance-related injuries and in becoming a strong athletic training educator has been guided by my PoAP. This plan illustrates my path for increasing knowledge, clinical skills, expanding scholarly work and providing service to the athletic training profession.

Introduction

The PoAP allows the post-professional student to focus on a specific area of interest to gain advanced knowledge (Nasypany et al., 2013) assisting the athletic trainer to become an advanced scholarly practitioner with deep and broad understanding and expertise in a focus area (Nasypany et al., 2013). The PoAP requires self-evaluation, through which the DAT student identifies strengths and weaknesses to develop a structured and measureable plan to progress toward advanced practice. Strengths and weaknesses in clinical practice, basic scientific knowledge, research capabilities and pedagogical strategies are addressed in my PoAP. As I have gained experience during the DAT program, my PoAP has evolved and allowed me to progress toward becoming an advanced practitioner in evaluation and treatment of dance-related injuries and in athletic training education. Achieving status as an advanced practitioner in these areas of focus will require staying current in literature and continuing to build knowledge by pursuing continuing education. My PoAP will continue to evolve as my clinical practice grows and new questions are formed.

Reflection on Professional Development

My professional experiences prior to the DAT program formed the basis for strengths that I further developed through my DAT training (e.g., effective clinician-patient communication and pedagogy with a focus on independent learning), while also fostering my interests in athletic training, dance-related injuries and athletic training education. Exposure to clinicians as an injured athlete in high school sparked my original interest in physical medicine, in particular my enjoyment of patient interactions and helping to improve patient functions needed for daily activities. As an undergraduate athletic training student, I noticed the information taught in the classroom fell short of what I was learning at clinical sites with my preceptor (e.g., palpations were practiced that had not been discussed in class), an observation that has led me, as an athletic training educator, to link classroom theory to clinical education in practical ways. My exposure to an excellent teacher at Slippery Rock University and my teaching experiences through the Master of Science in Education program at Old Dominion University inspired me to pursue a career in athletic training education, a decision that has been reinforced by my positive experiences in the classroom and working as a professor, preceptor and mentor at the Massachusetts College of Liberal Arts (MCLA). I gained invaluable clinical and administrative experience as an assistant athletic trainer and Clinical Education Coordinator at Concord University. My exposure to the Commission on Accreditation for Athletic Training Education (CAATE) accreditation process at Old Dominion University and at Concord University inspired my enthusiasm for becoming a site visitor and allowed me to facilitate accreditation for the Athletic Training program at MCLA. Finally, my primary clinical focus at MCLA, providing healthcare services to the dance

company, has led me to explore the literature related to treatment of dance injuries and identify research opportunities in the field.

Reflection on pre-doctoral experiences

My pre-doctoral experiences brought several priorities into clear focus. First, I acknowledged a need to develop my knowledge base with regards to pathophysiology, diagnostic strategies and effective interventions for various types of injury. My knowledge of dance-related injuries in particular would need to be strengthened, given my current patient population. Second, I recognized my desire for a relatively low-volume clinical practice that would allow in-depth communication with patient while providing opportunities to practice and assess new clinical techniques. Third, I realized that I wanted to follow the example of my own mentors and become an exceptional educator in athletic training. In particular, I wished to bring real-life examples and practical skill development into my classes and preceptor hours, and to act as an effective mentor in both the classroom and the clinic. One of my undergraduate preceptors had a particularly engaging way of teaching (in the classroom and in clinical education), in that he forced students to take ownership of their education and meet his expectations that they work hard, think critically and come to the right answers. I adopted several of his teaching strategies into my own teaching philosophy (I clearly express my expectations to my students; I expect them to work hard in my courses and clinical placements; and I design assignments that require self-directed learning in order to foster independence, critical appraisal and transfer of knowledge).

Doctoral Education

I chose to pursue a doctoral degree as a means of advancing both my clinical practice and my career in athletic training education. The structure of the DAT program at the

University of Idaho fit with my personal and professional goals, given that it would allow me to advance my clinical practice and research skills while continuing to work full-time. During my time in the DAT program, I have advanced my knowledge through participation in coursework and conferences, improved my pedagogical skills through incorporation of evidence-based practice, improved my clinical skills through application of new techniques for evaluation and treatment of the lower body, and developed my scholarship skills through evaluating patient outcomes and disseminating research findings.

Reflection on Current Knowledge

Becoming an Advanced Practitioner requires development of a strong knowledge base in areas of advanced practice. As an athletic training educator and practicing clinician in a performing arts setting, I must have advanced knowledge in my focus areas of athletic training education (administrative strategies as well as pedagogical strategies) and dance-related injuries (evaluation strategies and interventions). In this section I reflect on my current levels of knowledge in my areas of focus with the goal of identifying content areas that can be improved through my PoAP. I use a three-level scale to rate my knowledge, with "novice" corresponding to the knowledge of an entry-level athletic trainer, "intermediate" corresponding to knowledge depth, understanding, and competence for an athletic trainer with 5-7 years of experience, and "advanced" corresponding to expert knowledge in specific areas of athletic training.

Effective work as an athletic training educator requires advanced knowledge of both administrative strategies required to run a successful academic program and pedagogical strategies that enhance learning in the classroom. My knowledge of administrative strategies has been enhanced by my experiences at MCLA, where my responsibilities include

administration of clinical sites, interactions with patients and students in the dance medicine clinic, service on academic committees, interdepartmental collaborations and CAATE accreditation work. As a program administrator I must stay abreast of potential changes in athletic training education (e.g., transitioning from professional bachelor's degrees to a professional master's degree) so that I can consider the implications for my program. Given my background and experience in administrative strategies, I rate my current knowledge in this field as advanced.

I have enhanced my pedagogical knowledge since beginning my DAT studies, particularly with regards to evidence-based practice. The emphasis of evidence-based practice in my DAT coursework has translated well into my classroom and laboratory settings. I feel that I have become a better educator as a result of my improved understanding of scientific concepts and research practice; I now place a strong emphasis on reading and evaluating primary literature in my courses. As a preceptor, I also emphasize evidence-based practice, and I feel that my students are better equipped to learn and apply new skills as a result. My knowledge of pedagogical strategies (e.g., incorporating primary literature) has improved and is being applied with success, but I feel that further exploration of evidence-based practice will allow me to design better assignments and experiences for my athletic training students. Advanced practitioners are translators, in that they can take evidence from the literature and apply it to clinical practice (classic EBP) or create evidence from practice (i.e., outcomes) and translate that into teaching or even bench research. Given my current application of these skills, I rate my knowledge in this field as intermediate.

Historically, the majority of my previous clinical experiences as an athletic trainer have involved football patients. Working with patients in a contact sport prepared me well for

emergency situations (e.g., fractures). I have always enjoyed emergency response procedures, and currently I am an instructor for the American Red Cross. Further, others have utilized my knowledge of emergency procedures as a reviewer of the textbook *Emergency Response Management for Athletic Trainers* (Miller and Barry, 2010). I rate my knowledge of emergency practice as advanced.

Through my work at MCLA and my DAT training, I have increased my knowledge of dance-related injuries. At the NATA Annual Meeting & Clinical Symposium, I had the opportunity to go backstage at Cirque du Soleil and learn about dance medicine in that context. The dance medicine workshop was particularly worthwhile for me because it reviewed emergency planning in the performing arts. I have been able to integrate concepts learned at this conference into my own clinical practice (e.g., reformatting the emergency action plans for the dance medicine venues). In addition, I read *Dance Anatomy* (Haas, 2011) and conducted an extensive review of the literature with regards to evaluation and treatment of injuries in dancers. I rate my knowledge of dance injuries gained through the literature review, clinical observations and clinical practice as advanced.

I developed a strong understanding of the Selective Functional Movement Assessment (SFMA) through my DAT training. I read the textbook *Movement: Functional Movement Systems: Screening, Assessment, Clinical Strategies* (Cook, 2011), conducted a review of the literature with regards to the SFMA and watched the 15-hour "Functional Movement System" conference on Northeast Seminars. I have been able to apply this technique to my clinical practice and rate my knowledge as advanced.

I have made the greatest gains in my knowledge specific to the Mulligan Concept. I have watched all the Mulligan Concept videos available on Northeast Seminars, including

"Introduction to the Mulligan Concept:" "The Lumbar Spine;" "The Sacroiliac Joint and Hip;" "The Cervical and Upper Cervical Regions;" "The Hand, Wrist, and Elbow;" and "The Foot, Ankle, and Knee". In addition, I read the Mulligan text *Manual Therapy: NAGs, SNAGs, MWMs, etc.* (Mulligan, 2010) and *Mobilization with Movement: The Art and the Science* (Vicenzino and Hing, 2011). I participated in two Mulligan Concept courses: an introductory course focusing on the entire body and a lower body course focusing on the lumbar spine, hip, knee, ankle and toes. The greatest benefit of the introductory course was my detailed observation of the subtle adjustments in hand placement, which I was unable to adequately learn from videos alone. Following the introductory course, I was able to implement the Mulligan Concept in my clinical practice more effectively and with more confidence.

The second Mulligan Concept course was led by Dr. Frank Gargano. The course was focused solely on the lower extremity, the site for most complaints in my patient population. While at the conference, Dr. Gargano allowed time for me to speak with course attendees and introduce the DAT program, outline my research agenda, and explain how the Mulligan Concept is applicable for athletic trainers. The other conference participants were 28 physical therapists; I was the sole athletic trainer. The weekend I spent with Dr. Gargano helped advance my clinical practice of the Mulligan Concept by allowing me to become more skilled with the patellofemoral techniques and, importantly, perfect my hand placements.

This focus on the lower body has been particularly useful in my assessment and treatment of dancers. Based on my coursework and clinical experience using the Mulligan Concept with focus on the lower body, I rate my current knowledge in this specific field as advanced. Since my understanding of how to apply the Mulligan Concept to injuries of the

spine and other body regions is not as well-developed, I rate my knowledge of the Mulligan Concept overall as intermediate.

As I have learned more about dance-related injuries, I have gained a new appreciation for the regional interdependence of body movements and injuries that result from movement dysfunction. I conducted a literature review on the biomechanics of dance and etiology of patellofemoral pain, but I feel that I could increase my knowledge of movement dysfunction as part of becoming an advanced practitioner in evaluation and treatment of dance-related injuries and in athletic training education; I therefore rate my current knowledge as intermediate. A specific component of movement dysfunction is impaired motor control, which can predispose a patient or performer more susceptible to injury. An understanding of the physiology behind motor control and the motor learning associated with developing motor control is important for understanding movement dysfunction, but I feel that my knowledge of motor control is at a novice level.

I also feel that I can continue to improve in the domain of treatment and rehabilitation. Many of the national conferences that I have attended have fallen under this domain. This is also a major focus of the DAT program's curriculum and philosophy on improving clinicians' basic scientific knowledge to improve patient care. The domain can be difficult to master due to the number of varying philosophies regarding treatment and rehabilitation of patients. While I have not become an expert in all philosophies, I have developed an appreciation for the variety of clinical strategies, particularly through viewing various options via Northeast Seminars and through course readings in the DAT program. I feel that this has made me more open-minded with regards to applying new interventions, and also more likely to critically evaluate different options for assessment and treatment. With regards to the entire scope of

philosophies regarding treatment and rehabilitation of patients, I rate my knowledge as intermediate.

Reflection on Strengths

Through the DAT program, I have learned to identify and further enhance my strengths through my PoAP. I have two areas of advanced practice: athletic training education and evaluation and treatment of dance-related injuries. My key strengths in the domain of education are communication in educational settings and use of evidence-based practice in the classroom and clinic. My key strengths in clinical practice are application of new strategies for evaluation and intervention, assessment and treatment of dance-related injuries and collection of patient outcomes.

Communication in educational settings

As an educator, I have had to develop particularly strong communication skills. These skills are evident in the classroom, where I make expectations clear and provide engaging and informative lectures. I listen to my students and make sure that they play active roles in the learning process, both in the classroom and in the clinic. My strengths in the classroom are evidenced by my strong evaluations from students, peers and administrators. I am also an excellent communicator in the clinic, explaining pathophysiology and expectations in language understandable to the patients and listening carefully to descriptions of symptoms and concerns. Modeling these communication strategies as an instructor and preceptor is an important aspect of my mentoring style.

Use of evidence-based practice in the classroom and the clinic

My skills related to scholarly practice have evolved during my DAT training, and my current focus on primary literature in the classroom and clinic is an important strength. For

example, in my upper-extremity course, the students must complete an evidence-based assignment in which they use primary literature to evaluate special tests. The athletic training students calculate sensitivity, specificity and likelihood ratios and then summarize how this could be applied to a patient. Students who complete this course are better able to find and interpret primary literature, and I feel that I prepare them well to answer their own questions about evidence-based clinical practice. As I pose questions and challenge students to turn to the literature in clinical settings, I encourage students to see clinical practice as a field that is constantly improving.

Application of new strategies for evaluation and intervention

I have gained substantial knowledge of Positional Release Therapy (PRT), Selective Functional Movement Assessment (SFMA), and the Mulligan Concept (MC) through my work in the DAT program. One of my strengths as a clinician is my ability to apply new techniques in my clinical practice, a process further described in detail in Chapter 3. I critically evaluated patient outcomes and, based on my findings, I refined my application of PRT and the MC in my patient population. I will build on this strength as I explore additional interventions as part of my PoAP.

Assessment and treatment of dance-related injuries

Through my reading and my discussions with dancers I have gained familiarity with dance terminology and a better understanding of how dance injuries occur. I apply my knowledge base in the clinic and have successfully employed new assessments and interventions, as detailed in Chapter 3. I am confident that my own research findings will add to the literature in the field of dance medicine.

Reflection on Weaknesses

Creation of a meaningful PoAP requires identification of areas for improvement. I have recognized several weaknesses that must be addressed in my PoAP. With regards to knowledge, I must continue to improve my understanding of motor control and classification systems for pathologies of the lumbar spine and pelvic girdle. I must also increase my dissemination of research findings by publishing the results of my action research in peer-reviewed journals.

Understanding of motor control

Neuromuscular motor control is a critical component of movement. Practice of proper movements, (e.g., dribbling a soccer ball or rehearsing dance steps) contributes to subconscious motor learning and could possibly reduce the likelihood of injury. Inadequate motor control, on the other hand, can make a patient or performer more susceptible to injury. Motor control is clearly an important concept for the athletic trainer, yet I feel that I have only the most rudimentary understanding of the physiology behind motor control and learning. My reading about and application of the SFMA have allowed me to gain an advanced level of assessing movement while manipulating motor learning; however, I must learn more about motor control on a broader level. In particular I must learn more about the basic mechanisms (e.g., physiology) of motor control and explore clinical applications beyond the SFMA assessment.

Knowledge of classification systems for pathologies of the lumbar spine and pelvic girdle

Through my research into classification of knee pathologies, I realized that there are many different classification systems, and that some are more applicable than others in evaluating knee injuries in dancers. I recognize that my ability to evaluate other body regions

could also be improved by having a greater understanding of classification systems. For example, I might implement the lumbar spine classification described by Fritz, Cleland, and Childs (2007), through which patients could be assigned to specific treatment groups (manipulation, stabilization, or exercise) in my clinical practice. *The Pelvic Girdle* by Diane Lee (2011) is an excellent reference that might also be used as a basis for classifying pathologies and treatments in my specific patient population. Given that pathologies of the lumbar spine and pelvic girdle are common in dancers, I must continue to improve my knowledge of classification systems for these injuries.

Publication in peer-reviewed journals

My publication record is a weakness that must be addressed as part of my PoAP. To date, I have been lead author on one published manuscript describing my research findings: "Patient Outcomes Utilizing the Selective Functional Movement Assessment and Mulligan Mobilizations with Movement on Recreational Dancers with Sacroiliac Joint Pain: A Case Series," published in the *International Journal of Athletic Therapy & Training* in May 2015. In the future, I need to better disseminate my patient outcomes to further advance the literature in the areas of dance medicine, patient outcomes, and the Mulligan Concept. I must publish the results of my action research project, then maintain a focus on publication as I continue my scholarly practice.

Clinical and teaching philosophies

I have given careful thought to the principles that guide my clinical work and my pedagogy as I have worked to become an advanced practitioner in evaluation and treatment of dance-related injuries and in athletic training education. My clinical and teaching philosophies

frame my current practices in the clinic and the classroom and help to guide the structure of my PoAP in these areas.

Clinical philosophy

> *To focus on patient-centered care by evaluating the patient as a whole (physically and emotionally) and by applying the principles of practice-based evidence. I will continue to make clinically informed decisions by using the process of reflective practice. I will continue to develop and question advanced practice knowledge in areas of interventions for dysfunction, impairment and injury. I will continue to improve my clinical skills throughout my career by pursing reflective practice and scholarly activity. Finally, I will continue to advocate for treating athletic trainers as qualified health-care providers.*

Teaching philosophy

> *To lead by example, become a role model and mentor, and advance student knowledge by serving as a leader in the athletic training profession. I will do this by practicing and teaching a patient-centered approach to include the psychological and pathoanatomical approach to evaluation and treatment. I will continue to be an advocate for the athletic training profession by instilling professional morals and a sense of life-long learning in students. I will do this by showing students how to apply practice-based evidence through the use of reflective practice. My teaching philosophy at times will merge with my clinical philosophy; and both philosophies will remain fluid as I reflect on my experiences and respond to changes in the athletic training profession.*

Goals of the Plan of Advanced Practice

With my clinical and teaching philosophies as guides, I have identified a series of goals that will allow me to progress towards becoming an advanced practitioner in evaluating and treating dance-related injuries and in athletic training education. I have framed these goals around my clinical development (develop a greater knowledge base, expand clinical skills, continue to conduct and publish scholarly research), my development as an educator (improve pedagogy) and my position as a leader in the athletic training profession (continue to make meaningful contributions to the profession), as outlined in Table 2.1.

Table 2.1. Focus areas and specific tasks associated with my PoAP

Goal	Timeline
Expand knowledge base	
• Read *Motor Learning and Control: Concepts and Applications* by Richard Magill	Fall 2015
• Complete review of the literature regarding classification systems for pathologies of the lumbar spine and determine which is best applicable to dance injuries	Fall 2015
• Complete review of the literature regarding classification systems for pathologies of the pelvic girdle and determine which is best applicable to dance injuries	Fall 2015
Expand clinical skills	
• Read *Diagnosis and Treatment of Movement Impairment Syndromes* by Shirley Sahrmann	Winter 2015/16
• Read *Movement System Impairment Syndromes of the Extremities, Cervical and Thoracic Spines* by Shirley Sahrmann	Winter 2015/16
• Participate in a "Movement Systems Impairment Syndromes" course at the Washing University School of Medicine in St. Louis	Summer 2016
• Participate in Mulligan Concept course focusing on the upper extremity	Spring 2016
• Participate in Mulligan Concept course focusing on the sacroiliac joint	When next offered
• Read *Mulligan Concept of Manual Therapy: Textbook of Techniques*	Fall 2015
Conduct and publish scholarly research	
• Continue to collect patient outcomes and analyze results	Ongoing
• Publish initial case series for dancers with patellofemoral pain	Winter 2015
• Present research findings on the use of the Mulligan Concept for treatment of patellofemoral pain at a NATA	Summer 2016

conference	
• Present findings on the use of the Mulligan Concept for treatment of sacroiliac joint pain a national conference	Summer 2016
• Publish second manuscript describing results of survey for use of the Mulligan Concept by American Certified Mulligan Practitioners	Fall 2016
• Publish expanded case series for dancers with patellofemoral pain	Ongoing
• Publish expanded case series for dancers with sacroiliac joint pain	Ongoing
Improve pedagogy	
• Create a case study for use in my "Upper Body Assessment" course	Spring 2016
• Create a case study for use in my "Therapeutic Modalities" course	Fall 2015
• Create a clinical assignment in which students evaluate assessment techniques and apply them in the clinic	Ongoing
• Change format for practical exams so that the instructor serves as the standardized patient	Ongoing
• Design a possible masters program in Athletic Training for MCLA	Ongoing
Contributed to the Athletic Training profession	
• Continue to serve as a CAATE site visitor	Ongoing
• Send a letter to the Mulligan Concept Teacher Association describing the case for allowing athletic trainers to become Certified Mulligan Practitioners	Spring 2016
• Assist with development of specialty certification in the Mulligan Concept by communication with the NATA and the Board of Certification	Ongoing

Develop a greater knowledge base

I feel that I have built a strong knowledge base in terms of assessing and treating knee injuries, particularly through the use of the SFMA and Mulligan Concept. I have, however,

identified weaknesses in terms of understanding motor control and knowing classification strategies for pathologies of the lumbar spine and pelvic girdle. I will address these weaknesses by continuing to be a critical consumer of the literature. To apply this knowledge, I will then choose the strategy that best suits my patient population and evaluation techniques.

Expand clinical skills

I have successfully applied the SFMA in evaluating injuries to the lower extremity, but my clinical practice would benefit from application of additional evaluative paradigms, for example, the philosophy described by Dr. Shirley Sahrmann. I will also build on my success with the Mulligan Concept in treating patellofemoral pain syndrome (PFPS) by expanding my ability to apply this technique to other regions of the body. I would also like to become a Certified Mulligan Practitioner (CMP). The CMP certification is currently limited to medical doctors, osteopathic physicians, physical therapists, and chiropractors, but it is my hope that athletic trainers will be eligible for the CMP certification during the course of my PoAP and, as described in greater detail below, I intend to advocate for this.

Continue to conduct and publish scholarly research

A relatively small body of literature has been published with a focus on dance-related injuries, and athletic trainers are particularly well equipped to explore evaluation and intervention strategies in the performing arts. I will continue to disseminate my knowledge at conferences and in peer-reviewed journals targeted to both athletic trainers and the performing arts community. I will improve my skills as a scholarly writer by reflecting on and incorporating feedback from peers and editors as I write and co-write abstracts and manuscripts.

Improve pedagogy

I believe that my use of evidence-based practice in the classroom has enhanced the learning experience for my students and allowed them to develop skills in self-directed learning. I therefore intend to further incorporate evidence-based practice in my teaching. An additional pedagogical improvement will involve transition from anatomical models to the instructor as the standardized "patient" during practical examinations. Finally, I will explore alternative curricular options (e.g., transition to an entry-level Master's degree) as a means of better preparing students for the athletic training profession.

Continue to make meaningful contributions to the athletic training profession

As I become an Advanced Practitioner I will serve as a leader in the athletic training profession, both in my area of clinical focus and in my focus on athletic training education. In the summer of 2014, I sent a letter proposing specialty certification in the Mulligan Concept to the NATA and the Board of Certification, as I believe that wider training in and use of this technique will advance clinical practice in the profession. I will continue to advocate for this specialty certification. I will also advocate for allowing athletic trainers to hold the credential of Certified Mulligan Practitioner, a certification that athletic trainers cannot currently hold, despite the fact that athletic trainers are positioned to provide MWM interventions in many applicable situations.

Professional Goals

As an educator, it is my professional goal to become a program director for a professional Master of Science degree program. I would like to develop a curriculum to focus on patient-centered care, patient outcomes, improving basic science knowledge, learning advanced techniques and reflective practice. As a clinician is it my professional goal to

continue to provide high quality patient care in which patients improve their functional ability. I will continue to improve my standard of care through scholarly practice, and will continue to educate future athletic trainers in the clinic by serving as a preceptor. Finally, I have a long-term professional goal to develop Mulligan Concept courses for athletic trainers (e.g., as certifications).

Justification of the PoAP

The goals outlined in my PoAP were identified following reflection on my experiences, knowledge, strengths, weaknesses, clinical philosophy, and teaching philosophy. By working to address my goals with regards to knowledge, clinical skills, scholarly research, pedagogy and service to the profession, I will better position myself to become an advanced practitioner in evaluation and treatment of dance-related injuries and in athletic training education. Further, my PoAP will allow me to grow as an athletic trainer, and the external stakeholders (e.g., students enrolled in the athletic training program and patients treated in my clinical practice) and the athletic training community will also benefit from my PoAP. My students will see a better, more confident educator and preceptor. My patients will experience a clinician who treats them more effectively, in a shorter time, and with more successful outcomes. I am an improved clinician as a direct result of my PoAP and specific goals. The profession of athletic training will experience a positive impact from my PoAP as I conduct translational research that is disseminated through conference presentations and publications in peer-reviewed journals. I intend to make substantial contributions to the field in helping define best practices for evaluating and treating dance-related injuries to the lower body.

References

Cook, G. (2010). *Movement*. Aptos, CA: On Target Publishing.

Fritz, J., Cleland, J., & Childs, J. (2007). Subgrouping patients with low back pain: evolution of a classification approach to physical therapy. *Journal of Orthopaedic & Sports Physical Therapy, 37*(6), 290.

Haas, J. (2010). *Dance Anatomy*: Human Kinetics.

Krzyzanowicz, R., Baker, R., Nasypany, A., Gargano, F., & Seegmiller, J. (2015). Patient Outcomes Utilizing the Selective Functional Movement Assessment and Mulligan Mobilizations with Movement on Recreational Dancers with Sacroiliac Joint Pain: A Case Series. *International Journal of Athletic Therapy & Training, 20*(3), 31-37.

Lee, D. (2011). *The Pelvic Girdle An Intergration of Clinical Expertise and Research* (4th ed.). China: Elsevier.

Miller, M., & Berry, D. (2011). *Emergency Response Management for Athletic Trainers*: Lippincott Williams & Wilkins.

Mulligan, B. (2010). *Manual Therapy: NAGs, SNAGs, MWMs, etc.* (6 ed.). Wellington, New Zealand.

Nasypany, A., Seegmiller, J., & Baker, RT. (2013). *A Model for Developing Scholarly Advanced Practice Athletic Trainers in Post-Professional Education Programs*. Paper presented at the 2013 Atheltic Trainers' Educators Conference, Dallas, TX.

Vicenzino, B., Hing, W., Rivett, D., & Hall, T. (2011). *Mobilisation with Movement: The art and the science*. Elsevier Australia: Melinda McEvoy.

Chapter 3: Outcome Summary and Final Residency Findings

Introduction

I have made great improvements in my clinical practice since I began the DAT program. I have incoporated new strategies for evaluation, treatment and documentation of outcomes based on techniques explored through my DAT training. The purpose of this chapter is to provide information about changes in my patient care as I progressed through the DAT program. I describe my clinical practice setting, including the challenges I have faced as well as indentify patellofemoral pain syndrome as a treatment challenge. I describe the evolution of my clinical practice during my years in the DAT program, with focus on my clinical use of Positional Release Therapy (PRT) and the Mulligan Concept (MC) to evaluate and treat injuries within a dance population. Based on clinical outcomes, I provide critical reflection on the efficacy of these treatments. Finally, I describe my challenges and directions in clinical care for my future.

Clinical setting

My clinical practice is structured to serve patients who are members of a recreational, student-led dance company, an emerging setting in athletic training. The dance company leadership consists of an executive board of students and a faculty advisor, who provides guidance as needed. The company allows any student, regardless of dance competence, to join. This practice of open enrollment creates diversity in athletic competence, as the ability level and years of formal dance training vary greatly among members. The number of participating students is quite high, historically about one hundred students per semester. My primary role is to provide AT services to members of the Dance Company via open clinical hours (15-20 hours/week), in which any dancer may seek assistance regarding assessment and

treatment of general injury or illness. Also, at the end of each semester, I treat and provide care for injuries backstage during the dance company performances.

Being the first athletic trainer assigned to the dance company and as an athletic trainer working with dancers for the first time, I faced several challenges in my clinical practice. My biggest challenge was convincing the dancers to attend the clinic when injured. Prior to my work with the dance company, the patients had no dance-specific direct healthcare access. Many of the dancers, particularly those who have been dancing for years, have told me that they prefer not to seek care when they are injured. Part of this could be the "dancer's mentality" of attempting to dance through every injury, but I also feel that resistance to seeking assistance involves a lack of knowledge about the level of care provided by an athletic trainer. To improve patient usage or understanding of the benefits to the athletic training clinic, I made the clinic welcoming and have taken care to educate my patients so that the dancers who received treatment were more likely to promote the clinic to their peers. I feel that my personality has greatly assisted me in this; I am generally approachable and good-natured, and I feel that I communicate well with my patients. I believe my successful patient outcomes have also contributed to a positive view of the athletic training services. I have observed a dramatic increase in attendance, from twenty patient visits during my first semester, to over ninety patients this past fall.

A second challenge for me has involved dance terminology and techniques. During my first weeks of work with the dance company, I found myself unable to fully understand what the dancers were describing to me in terms of movements. To address this I reviewed the literature related to dance injuries and requested that the patients demonstrate movements that I could not visualize. As my confidence with dance terminology increased, I noticed that the

trust level also increased. As a result of my improved patient care strategies and dance knowledge my clinical environment has improved.

While working with the dance company I have noted interesting injury patterns. The dancers most commonly present with injuries involving the lumbar spine, sacroiliac joint and knee, with the knee (48%) being the highest. The number of patients complaining of knee pain is higher than has been reported in the literature (11-34%) (Baker, Scott, Watkins, Keegan-Turcotte, & Wynn; 2010), while the numbers of foot (10%) and ankle (13%) injuries observed with the dance company more closely matched the ranges previously reported (5-9% and 14-24% respectively) (Baker et al., 2010). In my patient population, patients with knee injuries typically complain of pain in the lateral knee and infrapatellar tendon while dancing, going up stairs and squatting. Recognizing I had not seen meaningful changes in patient symptoms prior to the DAT program using traditional interventions (e.g., quadriceps strengthening) to treat patellofemoral pain syndrome (PFPS), I explored alternative intervention strategies. This change in perspective provided the foundation for my action research topic: utilizing the Mulligan Concept to treat dance patients complaining of PFPS symptoms.

Collection of patient outcomes

Gaining a depth of understanding of utilizing patient outcomes through the DAT curriculum has influenced not only my procedure for data collection, but also my choices of relevant outcome measures. Patient outcome measures can improve clinical practice by highlighting strengths and weaknesses in specific areas (i.e., treatment paradigms). I began the DAT program with no experience in critical evaluation of patient outcomes, nor had I documented the efficacy of my patient interventions. Outcome measures collected during my

clinical residency included disease-oriented evidence (DOE) and patient-oriented evidence (POE). Disease-oriented evidence measures, sometimes referred to as clinician-oriented measures, describe outcomes that are important to clinicians (e.g., range of motion or strength) (Hurley, Denegar, & Hertel., 2011). Disease-oriented evidence is objective in nature and may help clinicians understand more about a patient's pathology. Conversely, POE is of direct interest to patients, rather than only clinicians (Hurley et al., 2011). With POEs, sometimes referred to as patient outcome assessments, the patient typically completes a survey containing information regarding the pathology, functional limitations (e.g., pain with activities of daily living) and quality of life indicators. Patient-oriented evidence usually focuses on quality of life or the ability to function from the patient's view (Hurley et al., 2011). Patient oriented evidence measures are meaningful for the patient and powerful for the clinician, as they allow both parties to focus on and assess improvements in patient function and quality of life. In one example, the Patient-Specific Functional Scale (PSFS), the clinician and patient select up to three functional tasks (e.g., walking up stairs) for which the patient is noting pain or decreased function. The patient then performs these tasks and grades them on a 0 (floor) to 10 (ceiling) scale, with 10 corresponding to full function (Stratford, Gill, Westaway & Binkley, 1995). The clinician can assess efficacy of intervention strategies to assist the patient in meeting goals using the PSFS. Measures that are meaningful to clinicians and patients help improve patient complaince (e.g., attending appointments), outcomes, and patient care.

My clinical progression in the DAT program has led me to supplement familiar DOE measures such as range of motion and strength with POE measures such as the Disability of the Physically Active (DPA) scale and the numeric pain rating scale (NPRS). I have

documented patient outcomes using these and other assessments, and have reflected on and applied my findings. As a result I have been able to observe trends in my patient care, identify problem areas in my clinical practice and implement plans to make improvements. For example, critical evaluation of POE outcomes was instrumental in altering my clinical application of positional release therapy and expanding my use of the Mulligan Concept which will be discussed further in this chapter.

Clinical Practice: Analysis and Results

In this section I will illustrate clinical and scholarly growth by describing the evolution of my evaluation and treatment strategies for injuries of the lower body. I will explain why I chose to apply positional release therapy (PRT) and the Mulligan Concept (MC) in the clinic, and I will describe the associated clinical outcomes. Most importantly, I will explain how my choices of treatments and my scholarly practice have evolved based on my critical reflection regarding my patient outcomes.

Positional Release Therapy

I was first exposed to PRT in 2012, and started reading the text *Positional Release Therapy: Assessment and Treatment of Musculoskeletal Dysfunction* by D'Ambrogio & Roth (D'Ambrogio & Roth, 1997) prior to the start of the fall 2012 semester. Positional release therapy is a specific approach to detection, classification and treatment of trigger/tender points (Baker, Nasypany, Seegmiller, & Baker, 2013; Chaitow, 2007; D'Ambrogio & Roth, 1997; Speicher & Draper, 2006). With this technique, a position of comfort (POC) is found in a specific muscle to relieve tension via the muscle-spindle mechanism (Baker et al., 2013). As an indirect manual therapy technique, PRT utilizes the POC for a period of time (e.g., 90 seconds) to facilitate trigger/tender point relaxation (Baker et al., 2013; Chaitow, 2007;

D'Ambrogio & Roth, 1997; Speicher & Draper, 2006). I gravitated towards PRT for two reasons: 1) I was able to grasp the concept easily and translate it well into my clinical practice, and 2) I expected it would provide my patients with positive results. As I worked with the Dance Company in the fall of 2012, I began to incorporate this interventional strategy into my clinical practice.

PRT: Initial use and reflection

The first patient I treated with PRT was a 21-year-old theater major, who was a member of the Dance Company. Upon presenting to the clinic, the patient complained of bilateral knee pain for almost a year. Her pain was located at the patellar tendon, lateral aspect of the knee and distial iliotibial band. The patient's pain increased while she was building performance sets (e.g., ascending/decending ladder), squatting for long periods and dancing. I saw the patient for seven treatments over a month and a half. On the first day of treatment the patient reported an overall decrease on the NPRS (10 = worst pain imaginable and 0 = no pain) from a 7 to 2 for a change of five points, a minimal clinically important difference (MCID) (Farrar, Young, LaMoreaux, Werth, & Poole, 2001). An MCID on the NPRS is a decrease of 33% or 2 points (Farrar, Young, LaMoreaux, Werth, & Poole, 2001). Her NPRS scores fluctuated throughout treatment, but at discharge her NPRS score was 2. The patient's DPA scale score was initially 42, and in the first week only a decrease to 39 was reported. A three-point change is not considered an MCID on the DPA scale; a change of six points or more is required for persistent (chronic) injury and a change of nine points is required for an acute injury on this scale (Vela & Denegar, 2010). Although my intervention did not result in an MCID in her disablement score, I was able to decrease the patient's pain and improve her function.

The second patient treated with PRT was a 19-year-old female dancer who complained of medial knee pain while dancing with two months of dance experience, most often while squatting and rotating during dances. Upon palpation only one tender point, on the soft tissue next to the superior medial aspect of the patella was identified. After three treatments of PRT her NPRS score decreased from 5 to 0, an MCID (Farrar et al., 2001). Her DPA scale score decreased from 51 to 35, an MCID for persistent injury (Vela & Denegar).

The final patient that was treated with PRT during the first semester was an 18-year-old female dancer who presented with left lateral knee pain. The patient complained of pain while going into a squat and during high-impact dancing (i.e., multiple rehearsals in one day). During the evaluation, she stated her pain was deep at the lateral joint line of the knee. She complained of tender points to the iliotibial band. I decided to treat her tender points using PRT. The patient's initial pain score was 7 on the NPRS and her initial DPA scale score was 33. While she did have improvement in pain between the first two treatments, her pain level remained high. During the course of treatment (specifically the third treatment) she complained of symptoms (e.g., decreased ROM, joint popping and swelling) consistent with osteochondritis dissecans, a condition in which cartilage and a layer of underlying bone detach from a bone end. Futhermore, the patient had a positive Wilson's test, indicative of osteochondritis dissecans. In Wilson's test, while the patient is sitting, the tibia is internally rotated and the patient extends the knee. When pain is experienced the patient externally rotates the tibia. Wilson's test is considered positive if the patient experiences pain during extension with internal tibial rotation that is relieved by externally rotating the tibia (Wilson, 1967). Interestingly, the Wilson's test was negative during the initial evaluation. The patient was referred to an orthopedist, who confirmed osteochondritis dissecans via imaging. I

stopped using PRT and we progressed to therapeutic exercises. Prior to x-ray confirmation, I treated the patient eight times over one month. Her final NPRS score was 7 and her final DPA scale score was 30; neither score reflected an MCID.

Positional Release Therapy was my primary intervention choice during my first semester in the DAT program, but critical reflection on my patient outcomes revealed that better application of the technique might be needed and that alternate or complementary strategies might, in some cases, have been more appropriate. I also realized through collection of outcomes with PRT that improvements could be made in my documentation strategy.

As I reflected on the application of PRT across all three patients, I realized that my patients improved on the treatment day, but the improvement did not last until the next follow-up. Patients at the end of treatment still reported pain (NPRS scores of 2 and 7 for two of the three patients) and dysfunction (DPA scale scores of 39, 35 and 30). I suspected a problem with application (e.g., not holding position of comfort long enough), as I was still a novice practitioner of the technique. I decided that hands-on training in PRT, would reduce my concerns about user error and improve my application of the technique, so I set an immediate goal of looking for opportunities to obtain more training in PRT.

Upon critical reflection, I realized that PRT might, in two of the cases, have been applied in combination with another treatment, or have been rejected in favor of an alternate treatment. In the case of the first patient, increasing awareness of the pain might have influenced results. When I spoke to the patient about her DPA scale scores, she stated “by taking this survey [the DPA scale], I have better awareness of my pain now and a better understanding of it, which might be why my scores are higher.” In hindsight, I wish I had investigated the psychological aspect of this patient’s pain, and I think if I had used an

intervention such as Primal Reflex Release Technique™ (PRRT) in conjunction with PRT, her results may have been better. Primal Reflex Release Technique™ is a manual therapy technique that addresses muscle and joint receptors as well as spinal modulation and can offer a neural rebooting. Towards the end of my first semester, I decided to continue to apply PRT, but to do so more judiciously, and perhaps in concert with other interventions. Interestingly, after subsequently learning about the MC, I realized that PRT might not have been the best intervention for the patient with osteochondritis dissecans. A better choice may have been the MC non-weight-bearing internal tibiofemoral rotation and possibly a lateral glide, which has been documented in patients to improve pain and function (Takasaki, Hall, & Jull, 2013).

I discovered at the end of the semester, when I wrote my case summary for my first patient, that improvements in documentation were needed. My notes were scattered, and important details were lacking in my evaluation notes (e.g., pain scale with palpation to triggerpoint). As a result of this critical evaluation, I created an online "cheat sheet" that provided more structure to collecting patient outcomes, allowed me to streamline documentation into a spreadsheet and to facilitate more purposeful analysis of data. The online spreadsheet proved to be helpful as I subsequently prepared presentations and manuscripts. I also took care to record pain outcomes with palpation both before and after interventions with subsequent patients.

PRT: continued application and reflection

In the summer of 2013 I fulfilled my goal of gaining more hands-on experience and training in PRT. I participated in a PRT-Institute (PRT-I) course on the spine and pelvis offered by Dr. Timothy Speicher, founder of the Positional Release Therapy Institute in Ogden, UT. Dr. Speicher confirmed that I needed to hold the POC longer, especially if the

patient was experiencing a fasciculation (i.e., a sensation in the soft tissue of pulsation and vibration; D'Ambrogio & Roth, 1997). Guided training and hands on practice allowed me to improve skills in palpation, pressure intensity and POC needed to effectively perform PRT.

As my understanding and application of alternate and complementary techniques increased (see the *"Mulligan Concept"* and *"Combination Therapy"* sections below), I decreased my use of PRT as a standalone treatment. My skills in PRT were improving, but I was applying the technique more judiciously. I treated only three patients exclusively with PRT in spring 2013 and fall 2014.

The first patient, seen in the spring semester of 2013, was a dancer who complained of neck tightness and pain with dancing and reading. A trigger point (7 on the NPRS with palpation) on her left upper trapezius near the C3 spinous process and a trigger point to her left levator scapulae near its origin at the C1 transverse process (6 on the NPRS with palpation) were identified. As I treated both trigger points with PRT, I was able to identify fasiculation. Based on my critical reflection of the previous semester, PRT was held for about three minutes at each site. Following treatment, the NPRS scores for both areas decreased to 2. Two subsequent treatments in the same session failed to decrease the NPRS score below 2. I treated the patient one more time, three days later and she reported no pain (NPRS = 0). Her DPA scale score decreased from an initial score of 42 to a final score of 7. This improvement, like that for the NPRS, was an MCID.

The second patient, seen in the fall semester of 2013, was a 20-year-old female dancer who complained of upper trapezius pain backstage prior to the fall dance show. The patient complained of feeling stressed due both to final exams and the upcoming performances. Her initial pain score with palpation to the left upper trapezius was 5 on the NPRS and her initial

DPA scale score was 19. Trigger points were noted at the left upper trapezius muscle; both rated as 5 on the NPRS. After performing three sets of PRT, while holding the POC for about two minutes per set, the patient reported all pain was eliminated. Post-treatment palpation to the upper trapezius and levator scapulae confirmed a score of 0 on the NPRS. The patient was able to dance in all three shows over the next two days with no return of pain. The patient had a follow-up appointment in the clinic three days later and stated her pain on the NPRS was now a 1 with palpation, only to the upper trapezius muscle. After placing her into a POC twice, holding for about two minutes each time, her pain with palpation decreased to 0. Her final DPA scale score was 3. Both her NPRS and DPA scale scores were at levels consistent with an MCID.

The third patient was, seen in the summer of 2014, was not from my dance population, but does illustrate the evolution of my use of PRT. The patient was a 28-year-old female who complained of chest pain for about two months. She was seen by her family physician, who had ruled out *Helibacter pylori*, a common cause of gastroesophogeal reflux disease, and heart conditions, based on lab work and a stress test, respectively. I noted while taking her history that her chest pain began with activity, yet she had no chest pain with exercise during the stress test. After further questioning, she realized that the pain was experienced only while doing yard work, carrying items (i.e., grocery bags) and sleeping on her left side. Based on a PRT scan of her cervical region, the patient had positive jump signs (i.e., a wince or increase in patient movement) on her anterior scalene and sternocleidomastoid on the left side, which caused her chest pain to increase to 9 on the NPRS. The patient had referred pain to her chest as well as the jump signs, leading me to believe that the tender points were, in fact, trigger points (D'Ambrogio & Roth, 1997). The first treatment using PRT, with three sets of

approximately three minutes each for both the scalene and sternocleidomastoid, eliminated both the jump signs and the referred pain. Her NPRS score decreased from 9 to 5 with palpation. At the start of the second treatment she had a positive jump sign, but her pre-intervention pain score with palpation to the previous areas with jump signs was only 6, compared to 9 prior to her first treatment. After the second treatment her NPRS score decreased to 3. She had no referred pain or chest pain in the two days between treatments. I gave this patient stretches to perform at home. I was unable to treat this patient more due to scheduling conflicts, however, she reported in the fall of 2015 that her NPRS is at a 1-2 most days.

My application of PRT with patients seen between 2013 and 2014 illustrates great improvement in my use of the technique. The first patient displayed an excellent outcome with PRT, but prior to the DAT program I would have used other interventions such as massage or trigger point release, and if I had seen this patient in 2012 she might have had a less satisfactory outcome, as I would have held the position of comfort for only 90 seconds. Proper technique and reflection is critical to improve patient care. I have learned that holding the POC when a fasciculation is identified and once it diminishes I can release my fingers, is essential in improving the patient's outcome. Physiologically, this is most likely due to fascial unwinding in the area of the tender point, neuromuscular feedback in the muscle spindle and a decrease in nociceptors in the area (D'Ambrogio & Roth, 1997). Without the fasciculation, the fascial system may still be dysfunctional. While the patient may have an initial improvement in pain and function, the improvement will most likely not last as long.

The experience with the third patient highlighted my new confidence with PRT, as I felt comfortable using the intervention even in a situation outside my usual patient population.

I felt that I was able to combine my improved palpation skills, improved depth and bredth of knowledge about PRT and enhanced decision-making to provide quality care for the patient. I initially applied the technique broadly, but after reflection on outcomes I learned to focus on specific situations for which PRT would most likely have a positive impact. I now turn to PRT specifically when a patient presents to the clinic complaining of muscle pain (i.e., tender point) or referred pain (i.e., trigger point) with palpation. Patients who demonstrate somatic dysfunction (e.g., loss of tissue tone or elasticity), fascial trauma (e.g., trigger point) or mechanically stressed tissues (e.g., dysfunctional posture) are excellent cadidates for PRT (D'Ambrogio & Roth, 1997).

The Mulligan Concept

As I reflected on my clinical outcomes after my first semester in the DAT program (Fall I), I identified a deficiency in my paradigm classifications. For example, what if a patient's dysfunction stemmed from the hip, but resulted in knee pain? I realized I needed to look beyond PRT, which I was using as a local treatment and improve my assessment and classification systems. As I progressed through the DAT curriculum, the intervention that most intrigued me based on my readings, was the Mulligan Concept (MC). The MC is a robust manual therapy intervention, and I was attracted to it because it can be used as both an assessment and an intervention.

The MC is named after Brian Mulligan, a physiotherapist in New Zealand. Most commonly referended as the MC Mobilization with Movement (MWM), is based on a positional fault theory. A positional fault is a subtle joint mal-alignment at a joint that can cause pain and dysfunction (Mulligan, 2010). A MWM is a joint mobilization, with movement into end range with overpressure being applied once at end range (Mulligan,

2010). A MWM should follow the P.I.L.L. concept: *pain-free, immediate and long lasting*. The MWM should be pain-free, with immediate decrease in pain or increase in function (e.g., range of motion), and long lasting, meaning the patient should maintain improvements over time. The MC MWM is a sustained passive accessory mobilization of an articular surface accompanied by movement (Mulligan, 2010). When the MC is applied correctly, the patient should not experience pain with the MWM. If the patient does feel pain, a slight change of angle, mobilization pressure, or hand placement may be indicated. If the patient continues to feel pain after a change of angle or hand placement, the MC should not be used. A successful patient outcome can include a decrease in pain level, increase in functional activity, increased range of motion or a lower level of disability.

To become familiar with the MC, I read Brian Mulligan's original book *Manual Therapy: NAGs, SNAGs, MWMs, etc* (2010) and *Mobilizations with Movement: The art and science* by Vicenzino, Hing, Rivett and Hall (2011). I also watched 51 videos about the MC on Northeast Seminars. I practiced MC mobilizations on athletic training students to develop my clinical skills and competence with the intervention prior to applying the technique in the clinic.

Mulligan concept: initial use and reflection

I first applied the MC on three dancers who presented with sacroiliac joint pain. The clinical observations, interventions and findings were published as a case series in the *International Journal of Athletic Therapy and Training* and are provided in Chapter 4. All three patients were treated with the Mulligan anterior innominate MWM or the posterior MWM, as appropriate. The DPA scale and NPRS scores decreased dramatically (MCIDs for

all patients), and pain was completely or nearly eliminated after 2-9 treatments (0-1 on the NPRS).

Prior to the DAT program I would not have considered the MC as a suitable intervention for these patients. I may have used a muscle energy technique instead, such as having the patient in a hook-lying position; my hands between the patient's knees, and having the patient squeeze and then push out. The patient's pain might have improved with this approach, but I doubt that the improvement would not have been as rapid or as long lasting as what was observed with the MC. I am confident that my choice of intervention and my clinical competence assisted the rapid and dramatic improvement for all three patients.

Use of the MC led me to appreciate its utility as an evaluative tool as well as an intervention. I was energized by my success with the MC in treating dancers with sacroiliac joint pain, and I decided to design my action research around use of this technique to evaluate and treat a more-common problem in my patient population, patellofemoral pain syndrome (PFPS). After reflecting on the improvements in my clinical skills gained through the PRT course, I also decided to pursue hands-on training in the MC, preferably with focus on the lower extremity.

Mulligan Concept: further training

In August 2013 I attended the Introduction to the Mulligan Concept Course in Kansas City, MO taught by Rick Crowell, PT and Certified Mulligan Concept Teacher. The introductory course reviewed techniques from the upper and lower extremities as well as a few spinal techniques. The hands-on component of the course was of particular benefit to me. I improved my hand placements for certain techniques, including cervical mobilizations.

In October 2013 I attended the Mulligan Lower Extremity conference in Solon, OH, taught by Dr. Frank Gargano, a Certified Mulligan Teacher. The lower extremity course covered the sacroiliac joint, lumbar spine, hip, knee, ankle, and toes. Dr. Gargano also discussed headache treatments, as treating headaches with the MC is one of his areas of expertise. Most importantly, I improved and refined my hand placement with various techniques and variations of mobilizations for the lower extremity, techniques that could be directly applied to treatment of PFPS as part of my action research. I have been able to incorporate many of the techniques I learned with Dr. Gargano into my clinical practice, particularly for patients with knee pain. These outcomes will be discussed in Chapter 5.

Mulligan Concept: continued application and reflection

I continued to apply the MC in my clinical practice as a strategy for evaluation and treatment of a variety of injuries. My primary focus was treatment of PFPS, as described in Chapter 5, but in the fall of 2013 I also applied the MC for patients with acute lumbar spine pain, shoulder pain and headache. The patient with acute lumbar spine pain, an 18-year-old female dancer, woke up with the pain but with no recollection of cause. The patient had difficulty walking into the clinic; she walked in a hunched-over manner and stated this position made her feel better. Palpation revealed acute spasm in her paraspinals to the left side, near the L2-L3 spinous processes. Her initial reported pain score on the NPRS was 7. Therefore, I used a sustained natural apophyseal glide (SNAG) into flexion at the L2-L3 level. Following the rule of three for spinal mobilizations during the first treatment, I performed three repetitions of a SNAG into spinal (lumbar) flexion with minimal overpressure. The patient was sitting on a treatment table; I stood behind her with the ulnar border of my right hand on her left paraspinal area near the L2-L3 facet plane. I placed a mobilization belt

around her hips and my lower buttocks and upper thigh. The patient moved into spinal (lumbar) flexion as I provided a sustained mobilization. Following the third repetition, her pain decreased to a 1 on the NPRS for a change of 6 points, an MCID. Over a period of 24 hours, her DPA scale score decreased from 46 to 7. She was seen for one more visit before being discharged. Her final NPRS was 0 and her final DPA score was 2.

The patient with right anterior shoulder pain, a 20-year-old female dancer, stated that her pain began while helping build a set for a theater production on campus. She had been hammering overhead for multiple hours a day for three days in a row. The patient reported pain levels of 7 at the subacromial space and biceps tendon during palpation. The patient had a forward head posture, with rounded shoulders. The patient reported symptoms and positive special tests (Yergason's, Neer's and Hawkins-Kennedy) for shoulder impingement. Her clinical presentation yielded two possible diagnoses: upper crossed syndrome or impingement. I performed a MWM to the humeral head while the patient moved into abduction and applied overpressure. In this case I was applying the MC as an evaluative tool; if her pain decreased with the MWM, more than likely a positional fault was present as opposed to impingement or biceps tendonopathy. The patient reported immediate improvement during the first MWM. Three more sets of ten repetitions were performed, transitioning from evaluation (sub-therapeutic) to treatment. In addition to the MWM, the patient was given exercises for her posture and rounded shoulders, as I still felt the upper crossed syndrome was contributing to the shoulder pain. The patient reported symptom resolution in three visits over three days. Her pain with palpation decreased from 7 to 0 on the NPRS and her DPA scale score decreased from a 29 to 0. Initially, she had positive special tests for impingement, however after applying a MWM to the humeral head in a posterior and

oblique direction, her symptoms were eliminated and the special tests were negative at discharge. This case demonstrates that utilizing the MC MWM, for what would commonly be diagnosed as shoulder impingement and would be treated for 4-6 weeks, was identified as an apparent case of shoulder impingement and allowed for a patient reported resolution in symptoms in 3 visits.

The patient with the headache was not one of my recreational dancers; rather she was a colleague from the Biology Department. She stated that the pain was intense, at a score of 9 on the NPRS. The patient stated that she often gets headaches, and that this headache was particularly severe. The physical examination was unremarkable. I decided to perform a Mulligan headache SNAG. The patient was seated and I stood beside her with her head cradled between my torso and my right forearm. I placed my right fifth finger on the spinous process of C2. The lateral border of my left thenar eminence was on top of my right fifth finger. I then provided a gentle pressure in the ventral direction and held for ten seconds. The patient stated that her headache pain was decreasing. I decided to repeat the gental pressure in the ventral direction three times. After one set the patient said with a surprise that her headache was now a 2 on the NPRS. I then performed one more set (eight repetitions), after which she reported no headache pain. The patient was shocked at how quickly her pain resolved and furthermore the pain did not return over the course of the day.

After refining my patient outcomes collection process at the beginning of Spring-I, I was able to more accurately evaluate the effectiveness of the MC for patients with sacroiliac joint pain, to disseminate my findings through conference presentations, and publish my finding in a peer-reviewed journal. As such, this contribution to the literature may allow novice users of the MC to consider this intervention for treatment of sacroiliac joint pain. The

process of preparing the manuscript also improved my confidence in producing and disseminating my clinical research.

Through my increased experience with new techniques, I have become more willing to apply new interventions (e.g., the MC) to treat my patients. Based on the outcomes, this has been a successful strategy. Prior to learning about the MC I would have used a different intervention for each of these patients. I might have treated the patient with acute lumbar spine pain with a form of electrical stimulation to attempt to decrease the pain-spasm-pain cycle. Given that most forms of electrical stimulation only offer pain relief for up to 2 hours (Starkey, 2004) and do not treat dysfunction, I expect that the electrical stimulation would have decreased the patient's pain only temporarily, whereas the relief provided by the MC is long-lasting. For the patient with acute shoulder pain, I might have used interventions such as ultrasound, stretching and strengthening. Although such interventions may have eventually helped the patient, the MC yielded improvements in a very short timeframe. A critical aspect of my growth as a clinician has involved the ability to evaluate situations for which specific interventions, or combinations of interventions, are warranted.

Combination of Interventions

My treatment of patients was not limited to PRT and MC in isolation. I used PRT in conjuction with the MC to help multiple patients. The first patient was a 19-year-old female dancer, who presented to the clinic with complaints of neck pain while reading and dancing. Palpation revealed a tender point to her upper trapezius muscle and a trigger point to her levator scapulae. Her initial NPRS was 7. I performed PRT in a position of comfort for about two minutes for three sets. After treatment, her NPRS decreased to 2. I then showed the patient MC fist traction, in which the patient makes a fist and places in between their sternal

notch and lower jaw. The patient then takes the opposite hand and places it on the occipital protuberance and pulls up creating traction at the cervical spine. She was instructed to do this at home. I treated the patient for three more visits in which I performed PRT as described previously and a MC SNAG into flexion at the C6 level. After three treatments the patient's NPRS decreased to 2 and her DPA scale decreased from 42 to 7.

Another patient that I performed PRT in conjunction with the MC is with a 18-year-old female dancer who complained of left achilles pain that radiated to the medial gastrocnemius muscle belly, where I also located tender points. She had decreased dorsi and plantarflexion at the ankle. Her initial NPRS was a 5. Her first treatment I performed PRT to the tender points along the medial gastrocnemius muscle belly. I then addressed the dorsiflexion restriction with a MC MWM into dorsiflexion. The patient was kneeling with the affected foot on a treatment table. The mobilization belt was wrapped around her achilles and the my pelvis. The patient then lunged forward into dorsiflexion while I maintained an anterior glide of the distal tibia and fibula while matching the movement of the patient. Three sets of ten MC MWM for dorsiflexion were performed. Finally, to address plantarflexion loss, I had the patient lie supine on a treatment table with the affected leg bent and heel flexed to 90°. I placed my hypothenar border of my hand proximal to the joint line and then placed my other hand around the talus. I glided the tibia and fibula posterirly then rolled the talus ventrally. After one treatment the patients NPRS decreased to 1. I treated this patient for three more visits before she reported a 0 on the NPRS while her DPA scale decreased from 36 to 3.

Pre and post measurements (e.g., NPRS) can provide guidance for treatment. For example, in the first patient with neck pain, I treated tender points within the muscle. After performing PRT, she did improve, but still felt restricted in her neck motion. I then chose to

treat her with the MC to aid in her articular restrictions. This allowed her to have an increase in range of motion (ROM), that was pain free due to having treated her tender points with PRT. Using a combination of treatment interventions, in a specific order, helped this specific patient.

Through clinical reflection, I realized I need to be judisious with interventions, otherwise I am not sure which intervention was most helpful. This can be avoided with a firm understanding of philosophy of each treatment intervention, understanding proper indications and with patient communication. I feel that I have improved in all three of these areas and the patients described in the *Combination of Interventions* section demonstrate clinical thought and growth.

Advances in Patient Care

I have made tremendous advances in my clinical practice since beginning the DAT program: I have learned and incorporated new techniques, effectively documented patient outcomes, evaluated efficacy of interventions and disseminated my findings. I feel that my initial adoption of PRT and subsequent changes in useage of this intervention reflect an ability to modify my clinical practice based upon reflection and outcome findings. In documenting patient outcomes, I now use measures that assess both DOE and POE, and I collect these measures both pre- and post-intervention, when appropriate. By critically appraising the literature I have learned new strategies for applying interventions such as PRT and the MC, and by disseminating my findings, I might improve use of the MC in the athletic training profession. I am most excited about my progress with the MC. As described in my PoAP, I will continue to develop my clinical competence in applying the MC to dance-related injuries

by attending an upper extremity course, continuing to document patient outcomes, continue to practice critical practice reflection and to disseminate patient outcomes.

Challenges in Patient Care

Through the DAT program, I have had many opportunities to reflect on my clinical practice. I believe the biggest challenge in my patient care, particularly with regards to applying and then reflecting on new interventions, was the small number of patients. Participation in dance company has dwindled from over one hundred students three years ago to about fifty students in spring 2014. My requests to become involved in patient care through intercollegiate athletics and intramurals were denied by the administration at my place of employment. Given the decrease in patient encounters (sometimes only 1-2 patients/week), I have had to look beyond my dance medicine clinic to sufficiently practice hand positioning and other aspects of the interventions. I practiced many of my new clinical skills on athletic training students. This was actually a great learning experience for both parties. I was in the position of teaching skills that I had not mastered, which encouraged me to explain my thought process as I was demonstrating, and the students learned advanced, cutting-edge skills not typically taught in professional athletic training curriculum. However, performing new skills on patients with real complaints is essential for developing deeper clinical understanding and knowledge. In the future, I hope to work with University administrators to allow an open clinic for all non-NCAA students, faculty and staff.

Another challenge in my patient care has involved learning how to collect patient outcomes in an athletic training setting. I read the literature regarding the clinimetrics of patient outcome measures and the need for collecting patient outcomes, but little has been published on the technical aspects of collecting patient outcomes in clinical practice (Sauers

& Synder, 2011; Sauers, Valovich Mcleod, & Bay, 2012; Valovich Mcleod, Lam, Bay, Sauers, & Snyder Valier, 2012). During the first semester and beginning of my second semester, my process of collecting outcomes involved trial and error until I found what worked best in my clinical setting. The "error" part was frustrating; for example, I failed to collect data on pain during palpation, range of motion, and pre- and post measures. My trial-and-error process led to the development of the abstract "Nuts & Bolts: A practical guide to collecting patient outcomes from a clinician's perspective," that was presented at the 65th National Athletic Trainers' Association Annual Meeting & Clinical Symposium in Indianapolis, IN, in June 2014. In the presentation I provided a roadmap for athletic training clinicians on how to collect patient outcomes in their individual clinical settings. Many of the topics included in the roadmap were from my personal experiences. For example, assessing the needs and issues (i.e., barriers) in clinical practice, assessing what is important in clinical practice (e.g., improvements in functional tasks), developing a plan to collect data (e.g., online method) and finally, scholarly reflection. The process of collecting outcomes is cyclical and will be driven by new outcomes and clinical meaningfulness.

A final challenge I had in my patient care involved my self-confidence while using a new intervention. I found it difficult to use a skill learned solely from watching a video and I always questioned if I was performing the skill properly. In the first semesters of the DAT program, I was hesitant to use the new interventions on patients. I used the interventions in the dance clinic only after I practiced on athletic training students and felt comfortable with the techniques. In doing this, I feel that I limited my growth and knowledge during the first semester and into the second semester. I addressed this challenge by participating in conferences with a hands-on focus for my interventions of interest. Through this

improvement, however, I made great progress towards becoming an Advanced Pratitioner in the Mulligan Concept, and my work with students in practicing these techniques has advanced my goal of becoming a strong educator in athletic training.

Final Residency Impact

My participation in the DAT program has had a positive impact on my clinical residency site. I have expanded my knowledge of dance-related terminology and injuries, which has improved the trust level in my clinical setting. I have learned about and applied new interventions that have had positive outcomes in treating sacroiliac joint pain, PFPS and other injuries. I have learned how to document outcome measures that allow patients to better understand their rehabilitation and that allow me to evaluate the efficacy of treatment options.

My clinical setting has become more professional through better understanding of appropriate terminology and clinical techniques gained through my DAT training. Students, faculty and most preceptors no longer use the words “athlete,” “trainer,” and “training room.” Instead, we use “patient,” “patient-athlete,” “athletic trainer or AT” and “athletic training clinic.” I have been able to show athletic training students evaluation techniques and interventions that I learned through the DAT program, and they have been able to apply some of these concepts in their clinical education experiences. From a clinical perspective, teaching athletic training students manual therapy skills allows the students to become familiar with paradigms I learned as a doctoral student. I feel that my clinical role as a mentor is to provide the student with such experiences so that they can progress and develop their own clinical philosophies early in their careers. This will directly benefit the profession of athletic training; enhancing patient care and clinical competence.

I have had stimulating conversations with the Director of Athletic Training Education at my current institution, who is also my attending clinician. We have debated the future directions of athletic training education, the rationale behind my choices of interventions for patients and ideas regarding curricular development. Through these discussions we have been able to foster the development of a new athletic training program. The goals of preparing students to be excellent clinicians and developing a scholarly passion are being met in our young program, and I am proud of this accomplishment.

The greatest impact of my clinical residency has been the improvement in my basic scientific knowledge, athletic training skills and confidence to treat patients. I have always been certain that I was a good athletic trainer, but through the DAT program I have realized that I can become much better. I now feel that I have the skills and thirst for a life-long endeavor of improving patient care and educating new cohorts of exceptionally competent athletic trainers. I am finishing the DAT program as a better educator, clinician and person.

References

Baker, J., Scott, D., Watkins, K., Keegan-Turcotte, S., & Wyon, M. (2010). Self-reported and reported injury patterns in contemporary dance students. *Medical Problems Of Performing Artists, 25*(1), 10-15.

Baker, R., Nasypany, A., Seegmiller, J., & Baker, J. (2013). Treatment of Acute Torticollis Using Positional Release Therapy: Part 1. *International Journal of Athletic Therapy & Training, 18*(2), 34-37.

Chaitow, L. (2007). *Positional Release Techniques* (3rd ed.). London, UK: Churchhill Livingstone Elsevier.

D'Ambrogio, K., & Roth, G. (1997). *Positional Release Therapy: Assessment & Treatment of Musculoskeletal Dysfunction* (1 ed.): Mosby.

Farrar, J., Young, J., LaMoreaux, L., Werth, J., & Poole, M. (2001). Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain, 94*(2), 149-158.

Hurley, W., Denegar, C., & Hertel, J. (2011). *Research Methods A Framework for Evidence-Based Clinical Practice* (1st ed.). Baltimore, MD: Lippincott, Williams & Wilkins.

Mulligan, B. (2010). *Manual Therapy: NAGs, SNAGs, MWMs, etc.* (6 ed.). Wellington, New Zealand.

Sauers, E., & Snyder, A. (2011). A Team Approach: Demonstrating Sport Rehabilitation's Effectiveness and Enhancing Patient Care Through Clinical Outcomes Assessment. *Journal Of Sport Rehabilitation, 20*, 3-7.

Sauers, E., Valovich Mcleod, T., & Bay, C. (2012). Practice-Based Research Networks, Part I: Clinical Laboratories to Generate and Translate Research Findings Into Effective Patient Care. *Journal of Athletic Training, 47*(5), 549-556.

Speicher, T., & Draper, D. (2006). Top 10 positional-release therapy techniques to break the chain of pain, part 1. *Athletic Therapy Today, 11*(5), 60-62.

Starkey, C. (2013). *Therapeutic Modalities* (4th ed.). Philadelphia, PA: F.A. Davis Company.

Starkey, C, Brown, S, & Ryan, J. (2010). *Examination of Orthopedic and Athletic Injuries* (3rd ed.). Philadelphia, PA: F.A. Davis Company.

Takasaki, H., Hall, T., & Jull, G. (2013). Immediate and short-term effects of Mulligan's mobilization with movement on knee pain and disability associated with knee osteoarthritis - A prospective case series. *Physiotherapy Theory & Practice, 29*(2), 87-95.

Valovich Mcleod, T., Lam, K., Bay, C., Sauers, E., & Snyder Valier, A. (2012). Practice-Based Research Networks, Part II: A Descriptive Analysis of the Athletic Training Practice-Based Research Network in the Secondary School Setting. *Journal of Athletic Training, 47*(5), 557-566.

Vela, L., & Denegar, C. (2010). The Disablement in the Physically Active Scale, Part II: The Psychometric Properties of an Outcomes Scale for Musculoskeletal Injuries. *Journal of Athletic Training, 45*(6), 630-641.

Vicenzino, B., Hing, W., Rivett, D., & Hall, Toby. (2011). *Mobilisation with Movement: The art and the science*. Australia: Churchill Livingstone.

Wilson, JN. (1967). A diagnostic sign of osteochondritis dissecans of the knee. *Journal of Bone and Joint Surgery*, *49A,* 477-480.

Chapter 4: Patient Outcomes Utilizing the Selective Functional Movement Assessment and Mulligan Mobilizations with Movement on Recreational Dancers with Sacroiliac Joint Pain: A Case Series

The following manuscript in its format was accepted for publication in the *International Journal of Athletic Training & Therapy* in May 2015.

Krzyzanowicz R, Baker R, Nasypany A, Gargano F, Seegmiller J. Patient Outcomes Utilizing the Selective Functional Movement Assessment and Mulligan Mobilizations with Movement on Recreational Dancers with Sacroiliac Joint Pain: A Case Series. *Int J Ath Train Ther.* 2015;31-37.

The sacroiliac joint (SIJ) has been identified as the origin of low back pain affecting 13-25% of patients.[1-3] In the dance population, low back pain has been reported to account for 12-23% of all injuries.[4-5] In the dance medicine setting, many patient report to the clinic complaining of low back and SIJ pain of unknown etiology.[4] The SIJ plays a vital role in the functional movement and biomechanics of dance. Turnout, or extreme external rotation of the hip, combined with the extreme range of hip extension can place the pelvis and lumbar spine under tremendous amounts of stress.[4] This combination can place a dancer at more risk of injury to the lumbar spine and SIJ.[6] A dancer suffering from SIJ injury may present with a variety of symptoms that could include: pain with palpation to the SIJ, pain with pelvic loading movements (e.g., hip external rotation combined with jumping, leaping, or twisting), and extension of the lumbar spine.[7] In addition to pain, SIJ injury could result in decreased mobility of the SIJ and dysfunctional movement of the SIJ.[7]

One potential treatment option for SIJ pain is the utilization of the Mulligan Concept Mobilization with Movement (MWM). A MWM is a manual therapy intervention developed by Brian Mulligan and couples accessory mobilizations with physiological motion to treat positional faults of joints.[8] Mulligan proposed that positional faults may result in subtle joint

mal-alignment, which produces altered joint function, pain, or decreased range of motion.[8] To date, the physiological process by which positional faults may cause musculoskeletal pain or dysfunction has not been clearly identified.[9] The MWMs used in this case series consisted of a posterior innominate, where the ilium is posteriorly rotated on the sacrum and an anterior innominate, where the ilium is anteriorly rotated on the sacrum.[8,9] To date, no research has been published investigating the use of MWMs for treatment of SIJ dysfunction.

Another option for treating SIJ pain is to use the selective functional movement assessment (SFMA), an assessment instrument used to capture dysfunction from a regional interdependence model and identify appropriate intervention strategies based on those findings.[10] The purpose of the SFMA is to provide a systematic approach to rank the quality of movement (e.g., full range of motion during movement) and the provocation of symptoms during a movement.[10] Once a top-tier assessment is completed, patients proceed through any breakouts that may be needed.

A breakout is performed any time a movement is not classified as functional nonpainful and is completed by the clinician using a movement pattern isolation map to identify potential causes for the dysfunction or faulty movement patterns. Breakouts are used to help guide the clinician to the area of dysfunction. Clinicians should break down painful movements after dysfunctional movements to reduce unnecessary pain provocation.[10] Each breakout ends with one, or a combination of three, patient classifications (1) tissue extensibility dysfunction (TED), (2) joint mobility dysfunction (JMD), or (3) stability or motor control dysfunction (SMCD). A TED could produce a dysfunctional nonpainful pattern by having dysfunctional movement, usually of tissues that span more than one joint (e.g., shortened tendons or scar tissue).[10] A JMD could produce a dysfunctional nonpainful pattern

due to the articular surfaces and contractile and noncontractile tissues that connect them having reduced mobility (e.g., facet syndrome).[10] A SMCD could result in a dysfunctional nonpainful pattern in two ways, either due to a stability dysfunction or due to a motor control dysfunction (e.g., neurological processing issue).[10] Once a breakout has been classified, the clinician should perform treatment and corrective strategies based on the functional diagnosis.[10]

Once a dysfunctional movement pattern is identified, the SFMA can also be used as an intervention using the paradigm of reset, reinforce, and reload.[10] Resetting includes using manual therapy techniques, such as the Mulligan concept, to treat the dysfunction (e.g., JMD). Reinforce includes stretching exercises, soft tissue mobilization, and forms of biofeedback (e.g., kinesiology taping), and reload includes therapeutic exercises to improve dynamic loading.[10] The 4 x 4 matrix is a functional exercise progression that begins in nonweight bearing and no resistance, and then progresses to standing and resistance (Table 1). The 4 x 4 matrix can be used as a progression model for increasing load and difficulty of exercises for the patient.

Table 1. 4 x 4 Matrix[10]

1 – Nonweight bearing	1 – No resistance (pattern assistance)
2 – Quadruped	2 – No resistance
3 – Kneeling	3 – Resistance (pattern assistance)
4 – Standing	4 – Resistance

The purpose of this investigation was to use the SFMA and Mulligan MWMs on recreational dance patients who complained of SIJ pain. Questions being investigated were:

(a) Does SFMA intervention and Mulligan MWM decrease the level of impairment in patients suffering from SIJ pain as measured by the Disablement in the Physically Active (DPA) scale? (b) Does SFMA intervention and Mulligan MWM decrease patients' reported pain on the Numeric Pain Rating Scale (NPRS)?[11,12] (c) Do dancers with SIJ pain present with similar movement dysfunctions as determined by an SFMA exam? We documented the outcomes of three consecutive patients who were diagnosed with SIJ pain and treated with SFMA interventions and Mulligan MWM.

Methods

An a priori case series analysis was used for the design for this study. Three consecutive recreational dance patients who presented to the Dance Medicine Clinic complaining of SIJ pain were included in the study. The patient population was a sample of convenience. All patients were evaluated by an athletic trainer currently enrolled in a doctoral program, with seven years' experience and one year of experience using the Mulligan concept. Patients were evaluated using a traditional orthopedic evaluation.[13] Once the orthopedic evaluation was completed, patients were then taken through the SFMA. Patients were classified into one of four groups: (1) functional nonpainful, in which movement is nonpainful and of great quality as defined by having movement that is of full ROM and no symptoms; (2) functional painful, in which the patient can perform the movement with great quality but has pain it; (3) dysfunctional painful, in which the patient has an abnormal movement pattern and associated pain with movement; or (4) dysfunctional nonpainful, in which the patient has a dysfunctional movement pattern, but does not have pain with the movement.[10]

Clinical outcomes utilizing patient-oriented evidence to determine the effectiveness of MWM and the SFMA as an intervention for SIJ pain are limited. Therefore, once the evaluations were completed, patients were then given patient-report outcome measures, the DPA scale, and the NPRS. The DPA scale is a patient-reported outcome instrument designed for the physically active. The DPA scale includes four outcomes measures, measures of impairments (IMPs), functional limitations (FLs), and disability (DIS), and includes questions regarding health-related quality-of-life (HRQOL).[14] The DPA scale is scored from 0 (floor) to 64 (ceiling), with 16 points being subtracted from the final tally to produce the patient's score at that time.[15] A change of 6 points for acute injury and 9 points for for chronic injury is considered a minimial clinically-important difference (MCID).[15] The NPRS is commonly used to measure pain intensity with patients being asked to rate their pain on a 0 (no pain) to 10 (worst possible pain) rating scale.[11] A 2 point change on the NPRS is considered a MCID.[11]

Case Descriptions

History

A summary of each patient's history is provided in Table 2. Each patient had a positive FABER (flexion, abduction, external rotation) test for pain over the SIJ and positive lumbar quadrant test for pain over the SIJ while extending and rotating toward the side that was bothersome. Each of the patients denied any history of spinal trauma, hip, or thigh pathology. Active, passive, and resistive range of motion assessment in trunk flexion and trunk extension did elicit pain in each patient. Leg-length testing and the neurological exam were unremarkable. All components of the examination and treatment of each patient were

provided by the same clinician. The institutional review board committee approved this study and each patient gave written consent before initial evaluation for inclusion in the study.

Table 2. Summary of Initial Physical Exams

Patient	Age (Years) and Sex	Years Dancing	Exam
1	18 / F	12	Patient 1, a recreational dancer, reported to the Dance Medicine Clinic complaining of low back pain that had persisted for a month. The specific dance movement that caused the most pain was when she laid supine for about 10 s, then jumped up into a Plié position. She reported her pain as a 3/10 on the NRPS while dancing and a 3/10 at rest. Clinical evaluation revealed pain (5/10) upon palpation of the left SIJ from the PSIS to the inferior sacral angle. The FABER and lumbar quadrant tests were positive for SIJ pain. Palpation of pelvic landmarks and a positive long-sit test indicated anterior rotation of the left innominate. Her SFMA resulted in a DN classification for the third cervical pattern to the right, multisegmental flexion, multisegmental rotation to the right, single-leg stance (bilateral), and overhead squat. Her SFMA breakouts indicated a SMCD; the incorporation of a MWM into the evaluation indicated an anterior positional fault of the SIJ, which signified the MWM was an appropriate intervention. The remainder of the orthopedic evaluation was unremarkable and she reported an initial DPA scale score of 31.
2	19 / F	16	Patient 2, a recreational dancer, reported to the Dance Medicine Clinic complaining of low back pain that had persisted for 12 months. She had sought out other treatment (e.g., electric stimulation, therapeutic exercises) previously from other clinicians without an improvement in her reported pain level. The patient reported that all single-leg functional movements, such as turning or squatting, produced pain (7/10) on the left side during dance activities. While at rest, her pain was reported as a 6/10 on the NPRS. Clinical evaluation revealed pain with palpation (5/10) of the left SIJ from the PSIS to the inferior sacral angle. The FABER and lumbar quadrant tests were positive for SIJ pain. Palpation of pelvic landmarks and a positive long-sit test indicated posterior rotation of the left innominate. Her SFMA results included DP patterns during multisegmental flexion and extension and overhead squat. She had DN patterns during multisegmental rotation to the right and single-leg stance (bilateral). Her SFMA breakouts indicated an extension JMD and a SMCD. This led us to choose MWM as an intervention to address the posterior positional fault. The remainder of the orthopedic evaluation was unremarkable and she reported an initial DPA scale score of 49.

3	18 / F	2	Patient 3, a recreational dancer, presented to the Dance Medicine Clinic complaining of right SIJ pain while participating in dance activities. The dance maneuver that produced the most pain (8/10) was going from a single-leg stance to a squat where she moved her hand across the floor and then returned to a fully erect position. She reported that her current pain had persisted for three days before reporting to the clinic for evaluation. Clinical evaluation revealed pain (7/10) with palpation over the right SIJ that referred into her gluteus maximus. The FABER and lumbar quadrant tests were positive for SIJ pain. Palpation of pelvic landmarks and a positive long-sit test indicated an anterior rotation of the right innominate. Her SFMA results included a FP pattern during the first cervical pattern and multisegmental rotation to the right. She had a DN pattern with multisegmental flexion and a DP pattern with single-leg stance (right side only) and overhead squat. Her SFMA breakouts indicated a hip JMD; the incorporation of a MWM into the evaluation indicated an anterior positional fault of the SIJ, which signified the MWM was an appropriate intervention. The remainder of the orthopedic evaluation was unremarkable and she reported an initial DPA scale score of 15.

Intervention

A Mulligan MWM utilizing the foundational principles described by Mulligan in his text were administered by the same treating clinician in each clinical case.[8] The direction of the applied mobilization was dependent on the innominate rotation of each patient. Each MWM was performed in three sets of 10 repetitions.[8] The MWM technique applied was based upon the recommendations found in Mulligan teachings and the "PILL" concept (i.e., pain free, immediate effects that are long-lasting) was followed with each patient during examination and treatment.[8,16,17] Patients were expected to be pain free and experience immediate relief while the MWM was being performed. Exercises were selected for each patient based upon the SFMA breakout findings, were based off of the 4 x 4 matrix of the SFMA, and were performed before the Mulligan MWM intervention.[10] The top-tier of the SFMA was not reassessed at discharge; only those patterns that were dysfunctional were reassessed. All patients were monitored for the rest of the academic semester.

To assess patient-reported outcomes a NPRS and the DPA scale were used pre- and post intervention. Patients completed NPRS pre- and post intervention at initial clinical examination and at each subsequent treatment, including at discharge. If a patient was discharged before the end of a week, the patient would complete the DPA scale during the discharge visit. All of the patients were instructed not to perform any other exercises or treatments during this time, but were allowed to continue to participate in dance activities as normal. Patients were discharged upon being pain free during dance activities and at rest, displaying functional nonpainful movement patterns in previously impaired patterns, and reporting a clinically-relevant DPA scale score. A clinically-relevant DPA scale score is a score that was within the established range of healthy people who have completed the DPA scale.[15]

Based upon the physical examination (e.g., palpation, long-sit test), patient 1 was classified as having an anterior rotation to the left ilium. To address the ilial rotation, an anterior MWM was applied. The MWM was performed by grasping and rotating the effected ilium posteriorly while stabilizing the sacrum and having the patient perform a prone press-up. The MWM was applied nonweight bearing for three sets of 10 repetitions during each treatment session. Rolling techniques were performed to address the core SMCD identified during the SFMA. The technique involved the patient rolling from prone to supine on both sides, while using the lower extremities and lumbar spine to initiate the movement. Rolling patterns were performed to assist with resetting foundational core stability and motor control patterns.[10]

Based upon physical examination (e.g., palpation, long-sit test), patient 2 was classified as having a posterior rotation to the left ilium. To address the ilial rotation, a

posterior MWM was applied. The MWM was performed with clinician mobilization of the SIJ anterolaterally through the thenar eminence on the posterior superior iliac spine and counter pressure on the other ilium to prevent the patient from rolling.[8] The patient also performed prone press-ups during the MWM. The MWM was applied for three sets of 10 repetitions during each treatment session. The SFMA breakouts led to stability exercises starting with pelvic tilts, progressing into a quadruped pattern, and finally finishing with double knee to single knee stability exercises to address the identified SMCD.

Based upon the physical examination (e.g., palpation, long-sit test), patient 3 was classified as having an anterior rotation to the left ilium. To address the ilial rotation, an anterior MWM was applied in the same manner as described for patient 1. The MWM was applied in nonweight bearing for three sets of 10 repetitions during each treatment session. The SFMA breakouts led to the identification of a JMD of the hip. Pelvic tilts and opposite arm-leg motion in a quadruped position were performed to address the JMD. The exercises were also meant to assist with the stability of the pelvic girdle.

Results

From initial treatment to patient discharge, patients 1 and 2 experienced a MCID on the DPA scale (9 points) for chronic pain, while patient 3 experienced a MCID for acute pain (6 points) (Figure 1).[14,15] Patient 3 was the only patient who was classified as being in acute pain. All three patients also experienced a MCID on the NPRS (2 points) (Figure 2).[11,12] All three patients had dysfunctional movement in the multisegmental flexion, single-leg stance, and overhead squat patterns using the SFMA. Two of the three patients (patients 1 and 2) also had a core stability or motor control dysfunction using the SFMA. All three patients'

dysfunctional individual SFMA movement patterns improved from dysfunctional to functional postintervention.

Figure 1. Changes in DPA Scale Scores

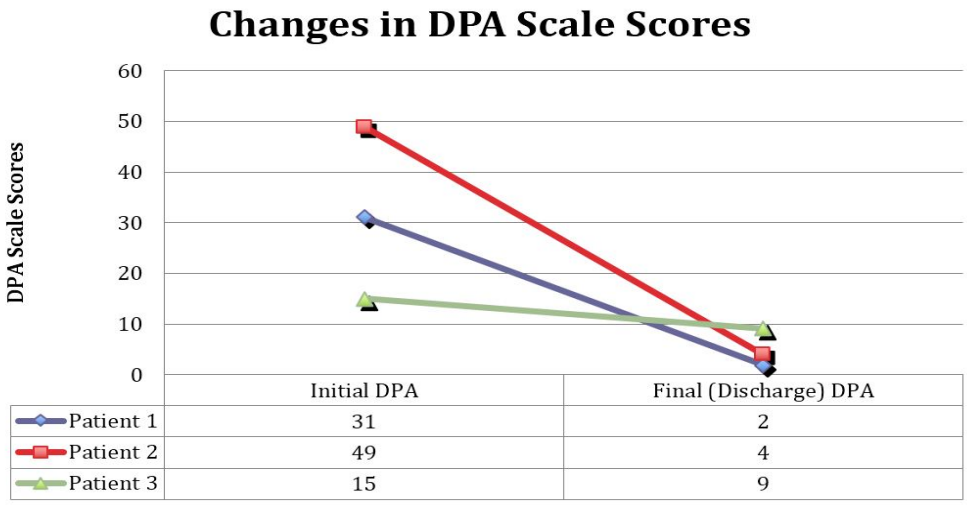


Figure 1. Disablement in the Physically Active (DPA) scale scores. *Note during initial evaluation all DPA scale scores were obtained. Patient 1 completed the DPA scale at 7 days (discharge). Patient 2 completed the DPA scale at 7 days and 18 days (discharge). Patient 3 completed the DPA scale at 5 days (discharge).

Figure 2. Changes in NPRS Scores

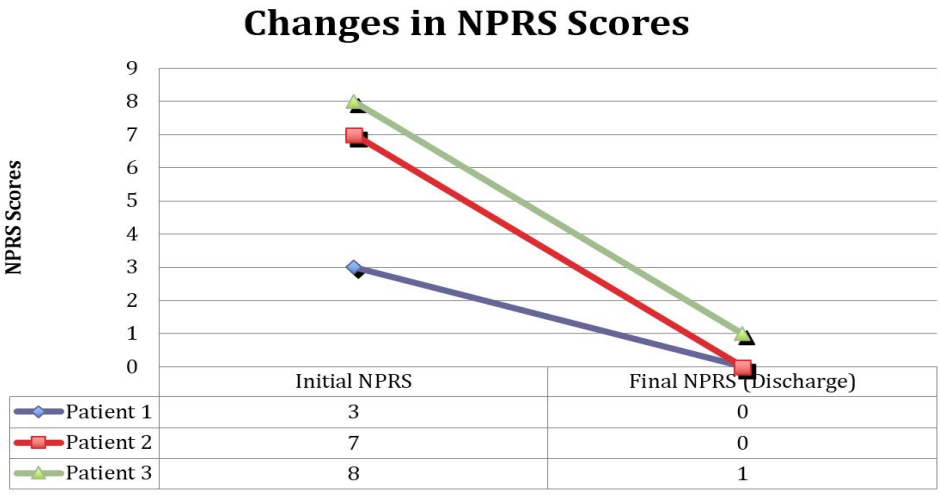


Figure 2. Numeric Pain Rating Scale (NPRS) scores from initial evaluation to discharge.

Discussion

Based on clinically-significant improvements on the NPRS, DPA scale, and SFMA classification, the combination of SFMA and MWM intervention was an effective intervention for the three patients in this case series. All improvements were maintained until the end of the seemster, an average of 52 days following intervention. The lack of a MCID for patient 3 on the DPA scale may have been as a result of her presenting with an initial score that would be considered low for persistent injury and within the range of scores of an uninjured population based on previous research.[14]

While the treatment intervention resulted in clinically-signficant results for each patient, variance was present regarding the number of treatments until discharge (Table 3). In this case series, it was noted that patients with a longer duration of symptoms (i.e., patients 1 and 2) required more treatments until discharge. All three patients were able to continue to participate in dance activities without restriction, while also completing the full dance season without a return to their original complaint. Following her discharge, patient 3 did later report pain (rated 1/10 on the NPRS), but continued to participate in her dance activities without further treatment or exacerbation of pain.

Table 3. Patient Treatment Time

Patient	Total # of Treatments	Total Treatment Days	Mulligan Technique
1	2	7	Anterior mobilization
2	8	18	Posterior mobilization
3	3	5	Anterior mobilization

Another interesting result of the case series was the identification of a consistent pattern during the performance of the SFMA. In each case, the patient presented with dysfunctional multisegmental flexion, single-leg stance, and overhead squat movement patterns. While the exact cause of this is unknown, pain and joint centration issues are possible explanations. Multisegmental flexion dysfunction may have resulted from pain[10] or altered biomechanics at the pelvic girdle, limiting flexion.[18] The overhead squat and single-leg stance movement patterns may have resulted from pelvic girdle dysfunction limiting motion[18] or pain inhibiting appropriate motor control during the movement pattern.[10] Further research should be conducted to determine if these movement pattern dysfunctions are commonly present in dancers with SIJ pain.

Previous research investigations have examined the effect of manual therapy on treating SIJ pain.[19-21] Cibulka[19] examined a manipulative technique in a case study of a patient with SIJ pain. The technique involved the patient lying supine with their hands interconnected behind their head; with the clinician stabilizing the anterior superior iliac spine of the opposite side, the clinician brings the torso up and performs a manipulation.[19] He concluded that manipulation could be an effective manual therapy for patients with SIJ pain.[19] Erhard et al.[20] examined patients with low back pain and classified them into an extension exercise group and a mobilization group.[20] The exercise group was treated with the McKenzie philosophy, while the mobilization group was treated using the same technique as described by Cibulka.[19,20] Erhard et al.[20] found that mobilization followed by general lumbar range of motion exercises improved patients' Oswestry Disability scores more rapidly than exercise alone. Visser et al.[21] demonstrated a 72% success rate in decreasing pain with two treatments

over the course of two weeks in patients with SIJ pain receiving high-velocity low amplitude (HVLA) thrust manipulations.[21]

In comparison, our results suggest even though different outcome measures were assessed than other studies, that a combined intervention aimed at treating movement dysfunction and positional faults in an individualized fashion may be effective (i.e., fewer treatments, improved patient- and clinician-outcomes) in treating SIJ pain. Despite the fact that dancers are perceived to be more hypermobile compared with the average patient,[22] the use of the SFMA was still able to identify movement dysfunction in this population. Using a movement assessment tool, such as the SFMA, may be valuable in helping clinicians detect movement dysfunction that may be related to SIJ pain. In addition, MWM may be able to be combined with SFMA-based interventions to immediately result in a decrease of pain and improve movement.

Limitations

The lack of a comparison group of patients with similar clinical presentation used to confirm therapeutic benefit is a primary limitation in this study; however, as this was an a priori designed case series, the results can be valued with greater strength than a retrospective case series. Only having three patients in the case series was a limitation, as having access to more patients possibly allows for better identification of trends present when using the SFMA in this population. The use of a specific outcome scale, such as the Patient-Specific Functional Scale and the use of the Oswestry Back Index could have been used so that the results could be more easily compared with out studies of SIJ pain. Additional research is needed to determine the effectiveness of Mulligan MWM and SFMA interventions on treating SIJ pain.

Conclusion

For this case series, the use of the SFMA and Mulligan MWM interventions was associated with clinically-significant improvements in pain using the NPRS, disability using the DPA scale, and functional movement using the SFMA for each patient. The ability to use patient outcome measures to effectively demonstrate whether a specific intervention choice produces a meaningful change for the patient is vital when examining the effectiveness of an intervention. Given that three consecutive patients with SIJ pain of varying duration (3 days to 12 months) improved in an average of 4.3 treatments, it would suggest that this intervention strategy was successful. Although our findings demonstrate the effectiveness of this intervention strategy, more research is needed to determine the physiological changes occurring, the effectiveness of each technique, and if the results are dependent upon specific classification as a responder to this approach at initial examination.

References

1. Coehn SP. Sacroiliac joint pain: a comprehensive review of anatomy, diagnosis, and treatment. *Anesth Analg*. 2005;101:1440-1453. PubMed doi: 10.1213/01.ANE.0000180831.60169.EA

2. Laslett M. Evidence-based diagnosis and treatment of the painful sacroiliac joint. *J Man Manip Ther*. 2008;16(3):142-152. PubMed doi: 10.1179//jmt.2008.16.3.14

3. Maigne JY, Aivaliklis A, Pfefer F. Results of sacroiliac joint double block and value of sacroiliac pain provocation tests in 54 patients with low back pain. *Spine*. 1996;21:1889-1892. PubMed doi: 10.1097/00007632-199608150-00012

4. DeMann LE, JR. Sacroiliac dysfunction in dancers with low back pain. *Man Ther.* 1997;2(1):2-10. PubMed doi: 10.1054/math.1997.0280

5. Micheli LJ. Back injuries in dancers. *Clin Sports Med*. 1983:2(3):473-484. PubMed

6. Reid DC. Prevention of hip and knee injuries in ballet dancers. *Sports Med*. 1988;6:295-307. PubMed doi: 10.2165/00007256-198806050-00005

7. Bronner S, Ojofeitimi S. Pelvis and hip three-dimensional kinematics in grand battement movements. *J Dance Med Sci*. 2011;15(1): 23-30. PubMed

8. Mulligan B. *Manual Therapy: NAGs, SNAGs, MWMs, etc.* 6 ed. Wellington, New Zealand; 2010.

9. Vicenzino B, Hing W, Rivett D, Hall T. *Mobilization with Movement: The art and the science.* Elseviet Australia: Melinda McEvoy; 2011.

10. Cook G. *Movement.* Aptos, CA: On Target Publishing; 2010.

11. Farrar JT, Young J, LaMoreaux L, Werth J, Poole M. Clinial importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain*. 2001;94(2):149-158. PubMed doi: 10.1016/S0304-3959(01)00349-9

12. Pool JJ, Ostelo R, Hoving J, Bouter L, de Vet H. Minimal clinically important change of the neck disability index and the numerical rating scale for patients with neck pain. *Spine*. 2007;32(26):3047-3051. PubMed doi: 10.1097/BRS.0b013e31815cf75b

13. Magee D. *Orthopedic Physical Assessment*. 5th ed. St. Louis, MO: Sunders Elsevier; 2008.

14. Vela LI, Denegar C. Transient disablement in the physically active with musculoskeletal injuries, part 1: a descriptive model. *J Athl Train.* 2010;45(6):615-629. PubMed doi: 10.4085/1062-6050-45.6.615

15. Vela LI, Denegar C. The disablement in the physically active scale, part II: the psychometric properties of an outcomes scale for musculoskeletal injuries. *J Athl Train.* 2010;45(6):630-641. PubMed doi: 10.4085/1062-6050-45.6.630

16. Folk B. Traumatic thumb injury management using mobilizations with movement. *Man Ther*. 2001;6(3):178-182. PubMed doi:10.1054/math.2001.0414

17. Paolina J, Mulligan B. *Mulligan Concept: Foot, Ankle & Knee Workbook.* East Hamstead, NH: Northeast Seminars; 2012.

18. Lee D. *The Pelvic Girdle An Intergration of Clinical Expertise and Research*. 4th ed. China: Elseviet; 2011.

19. Cibulka MT. The treatment of the sacroiliac joint component to low back pain: a case report. *Phys Ther.* 1992;72(12);917-922. PubMed

20. Erhard RE, Delitto A, Cibulka M. Relative effectiveness of an extension program and a combination program of manipulation and flexion and extension exercises in patients with acute low back syndrome. *Phys Ther*. 1994;74(12):1093-1100. PubMed

21. Visser LH, Woundenberg N, de Bont J, et al. Treatment of the sacroiliac joint in patients with leg pain: a randomized controlled trial. *Eur Spine J*. 2013;22(10):2310-2317. PubMed

22. Bowling A. Injuries to dancers: prevalence, treatment, and perceptions of causes. *BMJ*. 1989;298(6675):731-734. PubMed doi: 10.1136/bmj.298.6675.731

Chapter 5: Applied Clinical Research Project

Analysis of Patient Outcomes when applying the Mulligan Concept to treat Recreational Dancers with Patellofemoral Pain Syndrome

Patellofemoral pain syndrome (PFPS) is often considered a "catchall" diagnosis for patients with patellofemoral knee pain. Patients exhibiting patellofemoral dysfunction, iliotibial band (IT) pain, and patellar pain are often classified as having PFPS. Clinically, the exact cause of PFPS may be difficult to isolate due to potential involvement of multiple joints and structures, combined with similar symptom presentation. Additionally, patients often report pain (e.g., pain with prolonged sitting, pain going up and down stais, pain with squatting) and abnormal sensations (e.g., grinding or locking, squeaking in the knee) that mimic many knee pathologies (Herrington, Rivett, & Munro, 2006; McConnell, 1986; Puniello, 1993). Dancers in particular commonly report these signs and symptoms, often due to the stresses inherent in the turnout position (Coplan, 2002).

Turnout is often studied in performing arts medicine because this position is important to the aesthetics of dance and often alters the biomechanics of the lower extremity. Lack of turnout can cause a compensatory pattern, increasing stress on involved joints (e.g., tibiofemoral joint) (Coplan, 2002). Dysfunctional turnout can disrupt normal tibiofemoral joint dynamics by increasing the stresses placed on the medial collateral ligament and increasing stresses placed on the medial meniscus (Gilbert, Gross, & King, 1998). Therefore, a patient with tight lateral structures (e.g., the lateral retinaculum or IT band) may place an excessive load on the lateral patella, causing pain (Gilbert, Gross, & King, 1998; Wilk, Davies, Mangine, & Malone, 1998).

Patients presenting with excessive internal femoral rotation or excessive external tibiofemoral rotation may be predisposed to PFPS (Powers, Ward, Fredericson, Guillet, &

Shellock, 2003). Patients diagnosed with PFPS display greater internal femoral rotation angles in weight-bearing than in non-weight bearing positions, supporting the theory that dysfunctional joint alignment, such as increased femoral rotation, could result in patellofemoral pain or even subluxation (Powers et al., 2003). Evidence to support the link between increased femoral rotation and patellofemoral pain has been illustrated in the literature (Cibulka & Threlkeld-Watkins, 2005; Liporaci, Saad, Felicio, Baffa, & Grossi, 2013; Noerhen, Pohl, Sanchez, Cunningham, & Latterman, 2012; Welsh, Hanney, Podschun, & Kolber, 2010). With internal femoral rotation, the lateral articular surface of the trochlea impinges upon the lateral articular facts of the patella, pushing the patella medially (Lee, Morris, and Csintalan, 2003).

According to Lee, Morris and Csintalan (2003), external tibial rotation has been associated with a variety of patellofemoral dysfunctions, including compression syndromes. An increase in external tibial rotation has been shown to increase patellofemoral joint contact pressures at all knee flexion angles (Lee et al., 2003). In non-weight-bearing, an increase of tibiofibular rotation coupled with excessive internal femoral rotation might not be evident (Lee, Anzel, Bennett et al., 1994). The combination of internal femoral rotation and external tibiofibular rotation increases the risk of patellofemoral pain syndromes.

To assist with the proper classification of PFPS, Wilk, Davies, Mangie and Malone (1998) created a system that allows the clinician to apply treatment strategies and interventions for non-surgical management of PFPS according to the patient's specific classification (Wilk et al., 1998). Following a thorough examination the patient is classified into one of eight major divisions: patellar compression syndromes, patellar instability, biomechanical dysfunction, direct patellar trauma, soft tissue lesions, overuse syndromes,

osteochondritis dissecans and neurologic disorders. Utilization of the classification system allows the clinician to more specifically treat the underlying cause of the pain or dysfunction.

A variety of treatments for PFPS are available. The two main goals of treatment are to unload abnormally stressed soft tissue around the patellofemoral joint by optimizing the patellar position and to improve lower limb mechanics (McConnell, 2002). However, no consensus on the preferred treatment of PFPS has been established (Clark et al., 2002). Specific treatments such as patellar taping, strengthening of the quadriceps, hip musculature retraining and general therapeutic exercises have been studied (McConnel, 1986, 2007; Witvrouw et al., 2014). McConnell (2002) also stated that an anterior static evaluation with the patient weight-bearing can help the clinician observe internal rotation of the femur, which is a common finding in patients with PFPS.

A treatment option for patients diagnosed with PFPS is the Mulligan Concept (MC) Mobilizations with Movement (MWM). A MWM is a manual therapy intervention developed by Brian Mulligan and that couples accessory mobilizations with physiological motion to treat positional faults of joints (Mulligan, 2010). Mulligan proposed that positional faults may result in subtle joint mal-alignment, which produces altered joint function, pain or decreased range of motion (Mulligan, 2010). To date, the physiological process by which positional faults may cause musculoskeletal pain or dysfunction has not been clearly identified (Vicenzino, Hing, Rivett, & Hall, 2011). According to Vicenzino, Hing, Rivett and Hall (2011), a MWM is "likely to provide a potent stimulus that provides novel sensory input, novel muscle activation strategies and exposes the nervous system to new movement solutions." However, only initial experimental support for these mechanisms is available and more research in these areas is needed (Vicenzino, Hing, Rivett & Hall, 2011).

The MC has been successfully utilized to reduce pain in patients diagnosed with osteoarthritis at the knee. Takasaki, Hall and Jull (2013) identified the MWM that effected the greatest decrease in pain for each osteoathritic patient, then performed two sets of ten repetitions. The most commonly used MWM was tibial internal rotation. Although the tibial internal rotation MWM technique at the knee can be performed in weight-bearing, partial weight-bearing (squat) and nonweight-bearing, for the purpose of this manuscript, weight-bearing was the focus. The second most used MWM was a lateral glide. Overpressure was given once the patient was in full active range of motion (AROM) (Takasaki, Hall, & Jull, 2013). An important note is that all mobilizations must follow the P.I.L.L. method, pain-free, immediate and long-last reflief. Additional studies are needed to evaluate the efficacy of the MC MWMs in treating PFPS.

The purpose of this a priori case series was to evaluate the treatment effects of the MC MWMs, as carried out by a new practitioner of the MC, on dancers who were classified with PFPS. Patients with PFPS were classified according the system of Wilk et al., (1998). All were diagnosed with global patellar pressure syndrome or excessive lateral pressure syndrome and treated using a tibiofibular rotation MWM and a lateral glide for flexion MWM. Patient outcomes were assessed by measuring range of motion (flexion) and patient-oriented measures; Numerical Pain Rating Scale (NPRS), Disablement in the Phyiscally Active (DPA) scale and the Patient-Specific Functional Scale (PSFS).

Methods

Participants

The study was conducted in the Dance Medicine Clinic of a small university. Participants were dance patients who reported to the clinic for evaluation and treatment of knee pain.

Participants were identified and screened using the following inclusion criteria: ≥ 18 years of age, a member of the university dance company and diagnosed with global patellar pressure syndrome or excessive lateral pressure syndrome by a certified athletic trainer. Exclusion criteria included acute fracture, joint instability, history of surgery (e.g., reconstruction of the anterior cruciate ligament), rheumatoid arthritis, corticosteroid injection within the last 30 days, and the presence of open wounds. The principal investigator qualified five of the six consecutive patients who met initial eligibility requirements to participate in the study (N=5 females, age 20.4 ± 1.52 years). Informed consent was obtained at initial physical examination, and participants were instructed to continue normal daily activities (e.g., dancing, going to class) without restriction during the study period. Patients were discharged from care when their NPRS, DPA scale or PSFS score normalized and they had an increase in AROM. The Institutional Review Board at the clinical site approved all study procedures.

Evaluation

After consent was obtained, the principal investigator conducted a thorough history, including measures on the NPRS, DPA Scale and PSFS. A thorough evaluation was conducted on each patient including: palpation, manual muscle testing, ROM testing and special testing.

The NPRS, a patient-oriented measure that describes pain, is an 11-point scale that has a ceiling of 10 (worst pain) and floor of 0 (no pain). A minimal clinically important difference (MCID) is a decrease of 33% or 2 points (Farrar, Young, LaMoreaux, Werth, & Poole, 2001). Patient reported pain (NPRS) was recorded at initial examination, prior to each treatment session, following the completion of each treatment and at discharge.

The DPA scale, a patient-oriented evidence measure, has sixteen Likert-scale questions with a ceiling of 64 (worst) and a floor of 0 (best). An MCID is a 9-point change for acute injuries and a 6-point change for persistent injuries (Vela & Denegar, 2010). Healthy patients have a normative range from 0 to 34 (Vela & Denegar, 2010). The DPA scale was given to the patient during initial examination, at the end of each week of treatment and at discharge.

The PSFS is a patient-oriented evidence measure that describes a set of functional activities selected by the clinician and patient. The PSFS is an 11-point scale that has a ceiling of 10 (able to perform the activites at the same level as prior to injury or problem) and a floor of 0 (unable to perform the activites). An MCID is a change of 2 points (Stratford, Gill, Westaway, & Binkley, 1995) The composite is scored by the sum of activity scores divided by the number of activities. Patient-rated outcomes using the PSFS were assessed during the initial examination, following the completion of each treatment and at discharge.

Range of Motion (ROM) is a commonly used disease-oriented evidence measure that describes joint function. Active ROM for flexion was the sole joint movement assessed in this study. Active ROM was measured as described in *Measurement of Joint Motion: A Guide to Goniometry* (Norkin & White, 2003). Goniometric measurements were recorded using a standard goniometer, marked to 1° increments, during initial examination, prior to each treatment, following the completion of each treatment and at discharge. To ensure reliable data, the same clinician, using the same goniometer completed all pre- and post-treatment goniometric measurements (Brosseau et al, 2001). Active ROM was recorded at initial examination, prior to to each treatment session, following the completion of each treatment and at discharge.

The Thessaly test was used to assess integrity of the menisci. The test was performed by having the patient stand in a single-leg stance on the involved limb, grasping the clinician for stability. Once stable, the patient flexed her knee 5° and rotated internally and externally. The test was repeated at 20° of flexion. Specifically, for Thessaly's test, ROM was not assessed using a goniometer, similar to the technique described by Karachalios, Zibis, Zachos, Karantanas, & Malizos (2005). Positive responses included pain or a catching sensation at the joint (Karachalios et al., 2005). Sensitivity for medial meniscus is 0.71 and lateral mensicus is 0.78; specificity for medial meniscus is 0.87 and lateral meniscus is 0.90; positive likelihood ratios for medial menisus is 5.46 and lateral meniscus is 7.80; negative likelihood ratios for medial mensicus is 0.33 and lateral meniscus is 0.24 (Karachalios et al., 2005).

The Valgus test was used to assess integrity of the medial collateral ligament. The test was performed while the patient was supine. The clinician grasped the lower leg and pushed on the lateral aspect of the knee at 0° and 30°. Positive responses included pain and opening of the joint (Magee, 2008). Sensitivity is 0.86 while specificity is 0.93 (Harilainen, 1987). Positive likelihood ratio is 13.1 and negative likelihood ratio is 0.15 (Harilainen, 1987).

The Varus test was used to assess integrity of the lateral collateral ligament. The test was performed while the patient was supine. The clinician grasped the lower leg and pushed on the medial aspect of the knee at 0° and 30°, assessing the endpoint. A positive test included a diminished or absent endpoint (Magee, 2008). Sensitivity is 0.25 and specificity is 0.99 (Harilainen, 1987). Positive likelihood ratio is 17.3 and negative likelihood ratio is 0.76 (Harilainen, 1987).

The Lachman's test was used to assess the integrity of the anterior cruciate ligament. The patient was supine with the clinician's hands on the proximal tibia and around the distal

femur. The clinician applied a gentle anterior translation on the tibia, assessing the endpoint. A positive test included a diminished or absent endpoint (Magee, 2008). Sensitivity is 0.85; specificity is 0.94; positive likelihood ratio is 10.2 and negative likelihood ratio is 0.20 (Benjaminse, Gokeler, van der Schans 2006).

Ober's test was used to assess the integrity of the iliotibial (IT) band. The patient laid on the non-involved side while the clinician pulled the patient's leg dorsally, held it off the table, then released it gradually. If the leg dropped, the test was considered negative; if the leg stayed up, the test was considered positive (Magee, 2008; Piva et al., 2006). Currently, no data exists regarding sensitivity, specificity and likelihood ratios.

The lateral patellar tilt test was used for classification of patellar mobility. While the patient was supine, the clinician grasped the patella and attempted to lift it from the lateral edge of the femoral condyle. If the patella moved, it was classified as normal. If the patella did not move, it was classified as tight – more specifically, the lateral retinaculum was classified as tight (McConnell, 1986; Piva et al., 2006). Currently, no data exists regarding sensitivity, specificity and likelihood ratios.

Clarke's Sign was used for classification of patellar mobility. While the patient was supine, the clinician pressed down with the web of the hand at a position slightly proximal to the upper pole or base of the patella. The patient was asked to contract the quadriceps muscles while the clinician pushed down. If the test caused retropatellar pain and the patient could not hold a contraction, the test was considered positive (Magee, 2008). The positive likelihood ratio is 1.94 and negative likelihood ratio 0.69 (Magee, 2008).

The medial and lateral glide tests were used for classification of patellar mobility. While the patient was supine, the clinician pushed the patella medially, then laterally. The test was

considered positive if one-third of the patella failed to move over the femoral condyle or if the patella tilted up (Magee, 2008). Currently, no data exists regarding sensitivity, specificity and likelihood ratios.

Classification

Following clinical evaluation, a classification was made using the classification system of Wilk et al. (1998) (Table 5.1). The classification was made using information gained during the clinical evaluation including observation, palpation and special testing.

Table 5.1: Classification system of Wilk, Davies, Mangie, and Malone (1998)

Classification	Definition	Clinical Presentation
Excessive lateral pressure syndrome	Unilateral compression of patella or an over constrained patella, usually with tilting of the patella	Lateral retinaculum pain, pain near distal IT band and insertion at Gerdy's tubercle. Pain with stair climbing, squatting or stooping down.
Global patellar pressure syndrome	Both medial and lateral retinaculum are excessively tight. Can develop secondary to direct trauma or immobilization.	Diffuse anterior knee pain, globally around the patella. Restricted movement of the patella and atrophy of the quadriceps.
Patellar instability	Excessive movement, usually laterally, that can cause subluxation or dislocation of the patella.	Pain and/or instability of the patella, significant lateral tracking of the patella.
Biomechanical dysfunction	Biomechanical imbalances at other joints such as the foot and ankle, or limb length deficiency.	Complaints of general tightness in the lower extremity, and toe-out and/or pronation of the foot.
Direct trauma	Direct blow to the patella.	Pain with movement, possible dislocation or fracture.
Soft tissue lesions	Injury to soft tissue such as plica, infrapatellar fat pad or bursa.	Pain as a result of inflammation and loss of range of motion.

Overuse syndromes	Inflammatory reaction involving the tendon sheath.	Pain over the tendon and pain with activity, specifically jumping.

Treatment Intervention

After meeting eligibility requirements, each patient received care two to three days per week until discharge. Once classified, the internal tibiofemoral rotation MWM was performed as both a treatment strategy and as an evaluative tool. According to Mulligan (2010), patients should experience a P.I.L.L. effect if the MWM is indicated. The P.I.L.L. effect refers to pain-free, immediate, and long-lasting relief. The first MWM used with the patients was internal tibiofemoral rotation. The clinician knelt behind each patient, placed one hand on the fibular head and one hand on the proximal tibia and rotated the tibiofibular joint internally while the patient squatted, maintaining the mobilization through the movement. Each patient performed three squats while the clinician rotated the tibiofemoral joint internally. In patients that had a P.I.L.L. effect, three sets of ten repetitions were performed as described by Mulligan (Mulligan, 2010). In patients that did not have a P.I.L.L. effect (i.e., Patient 1), a modification of hand placement was performed and a P.I.L.L. effect was achieved. A prone lateral glide MWM was performed on all patients after the internal tibiofemoral rotation MWM was performed. The patient was prone on a table with a mobilization belt wrapped around their lower leg and the clinicians pelvis. The mobilization belt was positioned so that the proximal edge was at the tibial joint margin, a gentle lateral glide was applied by the clinician while the patient actively flexed the knee. Overpressure was given once the patient was in full active flexion ROM. Patients were told to inform the clinician if the MWM or overpressure was not pain-free. Only one patient (Patient 1) experienced discomfort. Since that discomfort was specifically due to the pressure from the belt, padding was utilized by the clinician along the

medial tibial joint margin. The patient subsequently reported no pain with the MWM and overpressure.

Data Management

The principle investigator managed all data. An online instrument (Google docs™ and Google drive™) was used to enter and store data. Athletic training students, trained in the use of the online instrument, entered data for several patients while the principal investigator reviewed all materials regarding each patient case, including diagnosis, treatment and data recording, to confirm the cases were handled in a manner consistent with the study methodology.

Results

Patient Descriptions

Table 5.2: Patient Examination Descriptions.

Patient	Age (Years) and Sex	# of Treatements	Examination
1	19 / F	20	Patient 1, a novice (i.e., no history of organized dance instruction) female dancer presented to the clinic with complaints of left lateral knee pain, near the insertion of the iliotibial band, which was exacerbated by squatting and going up stairs. Patient reported pain had been consistent over the previous three months, but the patient had not sought treatment. Patient was participating in a ballet piece when she felt the most pain during dance. The patient reported using cryotherapy and ibuprofen as self-treatments as needed during the summer, but with minimal improvement. During observation, it was noted that she had bilateral genu valgum. The patient also displayed positive signs (i.e., pain and decreased motion) during the lateral tilt, lateral patellar glide and Ober's test on her left side only. The remainder of the physical examination was unremarkable. Based upon her physical examination and positive special tests, using the Wilk et al (1998) classification system, she was classified as having excessive lateral pressure syndrome.
2	22 / F	3	Patient 2, an experienced female dancer, presented to the clinic with complaints of left knee pain inferior to the patella over the patellar tendon, along the lateral aspect of the knee to Gerdy's tubercle. Patient reported pain for two weeks prior to reporting to the clinic, primarily when performing the turnout position during a specific

			ballet piece. Patient could not remember a particular mechanism of injury, but had experienced diffuse intermittent knee pain during dancing in the past. The patient also displayed positive signs (i.e., pain and decreased motion) for her left knee during both lateral and medial patellar glide tests, as well as Clarke's sign. Based upon her physical examination and positive special tests, using the Wilk et al (1998) classification system, she was classified as having global patellar compression syndrome.
3	22/ F	6	Patient 3, a novice (i.e., no history of organized dance instruction) female dancer presented to the clinic with complaints of right knee pain by the distal iliotibial band bear Gerdy's tubercle and inferior to the patella, lateral to the patellar tendon. The patient complained of pain while performing a move on the floor in which she had to go from a supine position to a rotation. During evaluation it was noted that going from a supine position to a standing position caused valgus collapse. The patient also worked as a waitress and complained of knee pain while on her feet for long shifts (i.e., six hours or more) and pain while going up stairs. The patient reported no self-treatment and experienced pain for three weeks prior to presenting to the clinic. The patient also displayed positive signs (i.e., pain and decreased motion) for her right knee during the lateral tilt, lateral patellar glide and Ober's tests. The remainder of the physical examination was unremarkable. Based upon her physical examination and positive special tests, using the Wilk et al (1998) classification system, she was classified as having excessive lateral pressure syndrome.
4	19 / F	4	Patient 4, an expert (i.e., formally trained in ballet for 16 years) female dancer presented to the clinic with complaints of left lateral knee pain while squatting and going up stairs. Patient reported a sensation of pressure directly on the patellar tendon, with the pain present for about two weeks prior to examination. The patient's pain had increased during the increased dancing time required during show week. She also reported a history of chronic left ankle sprains. The patient also displayed positive signs (i.e., pain and decreased motion) bilaterally during the lateral tilt and lateral patellar glide tests. Uniquely, this patient had no pain with her right knee, even though special tests and observation revealed dysfunction. The remainder of the physical examination was unremarkable. Based upon her physical examination and positive special tests, using the Wilk et al (1998) classification system, she was classified as having excessive lateral pressure syndrome.
5	20 F	4	Patient 5, a novice (i.e., no history of organized dance instruction) female dancer presented to the clinic with complaints of left knee pain inferior to the patella at the patellar tendon for a month prior to seeking care. Patient reported pain while performing a squat during a hip-hop piece, as well as going up the stairs. The patient had taken ibuprofen for pain, but denied any other self-treatment. The remainder of the physical examination was unremarkable. Based upon her physical examination and positive special tests, using the Wilk et al (1998) classification system, she was classified as having excessive lateral pressure syndrome.

Mulligan Mobilizations with Movement

Four out of the five patients reported immediate improvements on the NPRS after the initial repetitions. Patient 1 did not have a pain-free and immediate relief effect during both the internal tibiofibular MWM and the lateral glide into flexion MWM. A simple shift of hand placement for internal tibiofibular rotation and padding for the mobilization belt during the lateral glide into flexion was all that was needed to create a pain-free and immediate relief effect. All five patients received the internal tibiofibular and lateral glide into flexion MWMs.

Global Patellar Pressure Syndrome

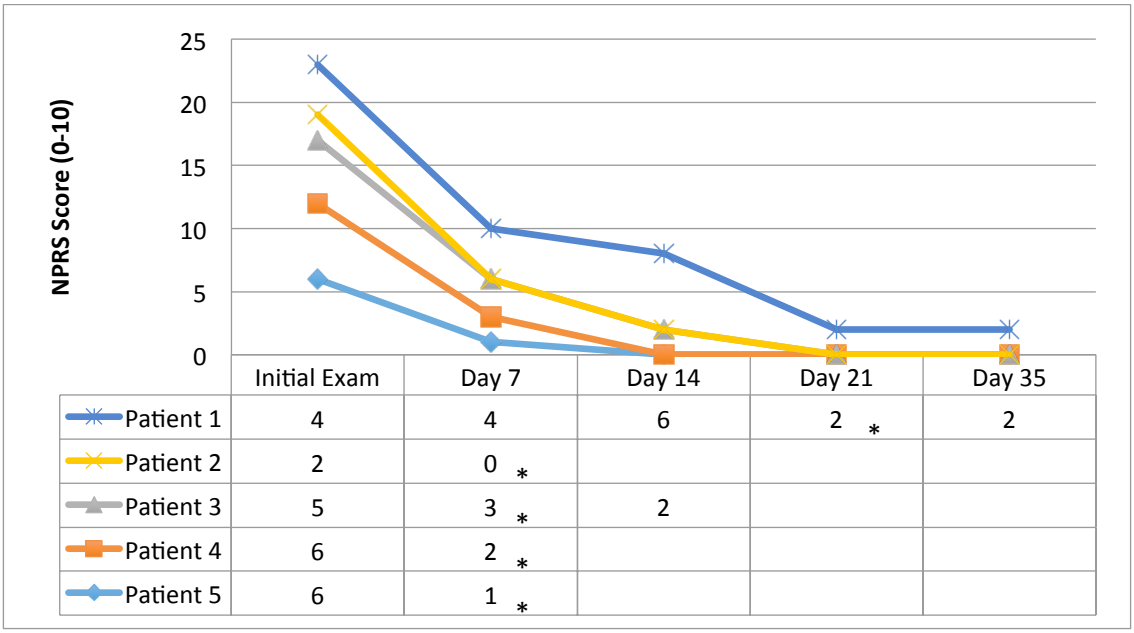
Only one patient (Patient 2) was classified with global patellar pressure syndrome. Following the first week of treatment, this patient exhibited an MCID of 2 points on the NPRS for pain during activity (Figure 5.1). Her functional activities on the PSFS are in Table 5.3. Patient 2 also exhibited a MCID on the DPA scale, from 21 at initial examination to 11 at discharge (Figure 5.2). AROM increased from 135° to 139° (Table 5.4). The patient was discharged once her NPRS score reached 0 and had an increase in function, as shown on the PSFS. Patient 2 continued to participate in dance throughout the study.

Excessive Lateral Pressure Syndrome

Patients 1, 3, 4 and 5 were all classified as having excessive lateral pressure syndrome using the Wilk et al (1998) classification system. After the first week of treatment, Patients 3, 4 and 5 exhibited an MCID on the NPRS for pain (Figure 5.1) during activity and an MCID on the DPA scale score (Figure 5.2). These three patients also exhibited an MCID on the PSFS (Table 5.3) and an increase in AROM of at least 6° (Table 5.4) at the time of discharge. Patients 4 and 5 were treated for one week; Patient 3 was treated for two weeks. Patients 1, 3, 4 and 5 all continued to participate in dance throughout the study.

Patient 1 was seen over 35 days (20 visits) prior to discharge. As indicated by her NPRS scores, her pain fluctuated throughout treatment (Figure 5.1). Her DPA scale scores decreased after two weeks of treatment and continued to decrease until discharge (Figure 5.2). Her PSFS improved, but not by clinically meaningful level (Table 5.3). Her AROM increased by 4° (Table 5.4).

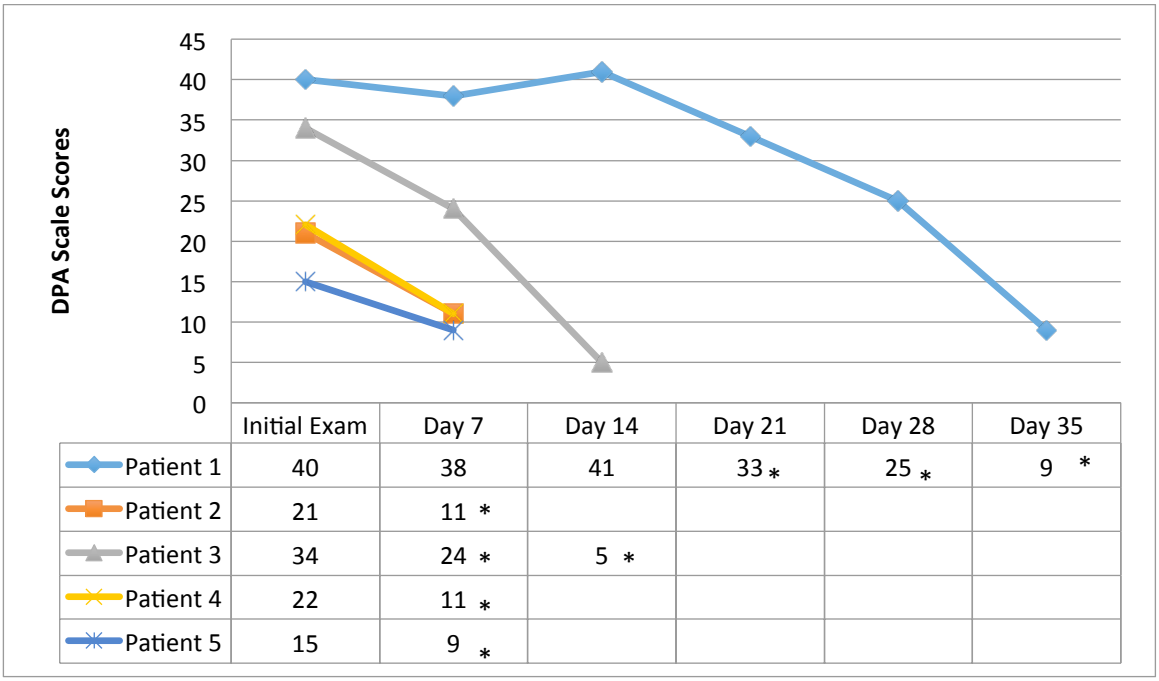
Figure 5.1: NPRS scores during physical activity decreased with treatment



	Initial Exam	Day 7	Day 14	Day 21	Day 35
Patient 1	4	4	6	2 *	2
Patient 2	2	0 *			
Patient 3	5	3 *	2		
Patient 4	6	2 *			
Patient 5	6	1 *			

* Minimal clinically important differences compared to the previous time point.

Figure 5.2: DPA scale scores decreased with treatment



	Initial Exam	Day 7	Day 14	Day 21	Day 28	Day 35
Patient 1	40	38	41	33 *	25 *	9 *
Patient 2	21	11 *				
Patient 3	34	24 *	5 *			
Patient 4	22	11 *				
Patient 5	15	9 *				

* Minimal clinically important differences compared to the previous time point

Table 5.3: Level of function increased on the Patient Specific Functional Scale (PSFS)

Patient	Activity	Level of Function at Initial Examination	Level of Function at Discharge
1	Going up stairs	7	8
	Squatting	6	7
2	Going up stairs	7	9*
	Turnout	7	9*
3	Going up stairs	6	9*
	Waitressing	5	8*
4	Going up stairs	7	9*
	Squatting	6	9*
5	Going up stairs	7	10*
	Squatting	7	9*

*Indicates a minimal clinically important difference

Table 5.4: Active Range of Motion (Flexion) Changes with Treatment

	Initial Evaluation (affected limb)	Discharge	Change	Initial Evaluation (unaffected limb)
Patient 1	119º	123º	+4º	113°
Patient 2	135º	139º	+4º	139°
Patient 3	128º	135º	+7º	137°
Patient 4	117º	125º	+8º	124°
Patient 5	124º	130º	+6º	130°

Discussion

In this a priori case series, the Mulligan Concept internal tibiofemoral rotation MWM and lateral glide into flexion MWM decrased pain, increased AROM and increased function in recreational dancers classified with global patellar pressure syndrome and excessive lateral pressure syndrome. The weight-bearing internal rotation MWM was performed on all patients, as all patients complained of pain with weight-bearing activity. Takasaki et al (2013) found that the weight-bearing internal rotation MWM resulted in an immediate reduction of pain during functional tasks (i.e., ascending stairs) in patients with osteoarthritis of the knee. Similar results have also been reported for MWMs of the extremities (O'Briend and Vicenzino, 1998; Vicenzino and Wright, 1995). Mulligan (2010) suggests the internal rotation MWM can be performed in non-weight-bearing, but this modification is recommended for patients with pain in non-weight bearing movements and/or osteoarthritis and was not used in the current study. Interestingly, a valgus collapse was seen in all five patients while in weight-bearing performing a double-leg squat. Valgus collapse can be correlated to lateral tibial torsion (externally rotated tibia) and lateral patellar alignment (Magee, 2008). Results from

the PSFS (e.g., ascending stairs) were also similar to those reported by Takasaki et al (2013) for osteoarthritis patients. The average increase in active knee flexion in our study (5.8°) was greater than that observed by Takasaki et al (2013) (3.9°), while the patients in Takasaki et al (2013) study were diagnosed with osteoarthritis and patients in this current study were classified with PFPS. Ellaszie, Young, Woodbury and Frydy-Field (1994) demonstrate that individual clinicians intragoniometer standard error of measure is 0.858°. The standard error of measure estimates how repeated measures of a person with the same instrument tends to be around his or her true score; however, the true score is always unknown (Hurley, Denegar, & Hertel, 2011). Moreover, knee joint flexion measurements are found to be more reliable than knee joint measurements (Piriyaprasarth & Morris, 2007).

Regarding patient classification, only one patient was classified as having global patellar compression syndrome. Global patellar pressure syndrome is thought to occur when both the lateral and medial retinacula are excessively tight (Wilk et al., 1998). While most patients develop global patellar pressure syndrome after a traumatic blow to the patella (Wilk et al., 1998), patient 2 did not report a mechanism of trauma. She did, however, display diffuse anterior knee pain globally around the patella, a cardinal symptom of global patellar pressure syndrome. Patient 2 also had positive medial and lateral glide tests, indicating that her patella was hypomobile in both directions (Paulos, Rosenberg, Drawbet, Manning & Abbot, 1987; Wilk et al., 1998). Based upon MCIDs on the NPRS, the DPA scale, the PSFS and increased AROM, Patient 2 had a positive outcome following MWM interventions. This is an observation from only one patient, but the results suggest further study is warranted, as most patients classified with global patellar compression syndrome undergo surgical procedures (Paulos et al., 1987).

Patients 1, 3, 4 and 5 were all classified with excessive lateral pressure syndrome. Variations in patient characteristics can explain the wide range of days treated in this group (average of 15.75 days). Patient 1, who was treated for 35 days, was also diagnosed with osteoarthritis on Day 30 of treatment. Retrospectively, patient 1's data appears to be an outlier as her immediate and long-lasting data points of the MC P.I.L.L. concept do not match similar reported outcomes of Patients 2-5. The principle investigator included her data to as she was orginially classified with PFPS and her AROM, NPRS and DPA scale measures were improving over the course of treatment. Patient 3 was also waitressing at the time of treatment (14 days) and Patients 4 and 5 were discharged after 7 days from initial evaluation. Excessive lateral pressure syndrome can be a result of dysfunction of the tibiofibular joint, which is commonly seen in dancers during the turnout phase of dance. Four of the five patients in this study participated in a ballet dance. A possible link between excessive lateral pressure syndrome and ballet dancing exists and needs to be examined further.

Limitations

Several limitations were identified in this study. The core limitation was the lack of a comparison group of patients with similar clinical presentation; this was an a priori designed case series rather than a randomized trial, and the number of patients (n=5) was insufficient for a comparison study. It is unclear if the observed results will apply to the general population of dancers with PFPS, or to individuals with PFPS participating in other activities. A larger sample size would be of benefit. Due to time restrictions, no long-term follow-up was performed to assess patient status following the intervention (e.g., at 6-months, 9-months and 1 year). Finally, the principal investigator of the study was initially a novice at applying

the Mulligan Concept; it is unclear if skill development over the course of the study period impacted results.

Conclusions

For this a priori case series, the use of the MC MWM internal rotation of the tibiofemoral joint and a lateral glide into knee flexion was associated with clinically significant improvements in patient-oriented and disease-oriented measures. At various points throughout the study, improvements in patient-oriented measures such as patient pain on the NPRS and patient function on the DPA scale and PSFS, were seen at levels consistent with MCIDs. Active range of motion, a disease-oriented measure, increased by an average of 5.8° in the five patients seen in this study. Further study is needed to validate the findings of the current study to validate the clinical efficacy of the Mulligan Concept MWMs.

References

Bowling, A. (1989). Injuries to dancers: prevalence, treatment, and perceptions of causes. *BMJ (Clinical Research Ed.), 298*(6675), 731-734.

Brosseau, L., Balmer, S., Tousignant, M., O'Sullivan, J., Gourdreault, C., Gourdeault, M., & Gringras, S. (2001). Intra- and intertester reliability and criterion validity of the parellelogram and universial goniometers for measuring maximum active knee flexion and extension of patients with knee restrictions. *Archives of Physical Medicine & Rehabilitation, 82*(3), 396-402.

Chatman, A., Hyams, S., Neel, J., Binkley, J., Stratford, P., Schomberg, A., & Stabler, M. (1997). The Patient-Specific Functional Scale: Measurement Properties in Patients with Knee Dysfunction. *Physical Therapy, 77*(8), 820-829.

Cibulka, M., & Threlkeld-Watkins, J. (2005). Patellofemoral Pain and Asymmetrical Hip Rotation. *Physical Therapy, 85*, 1201-1207.

Clark, D., Downing, N., Mitchell, J., Coulson, L., Syzpryt, E., & Doherty, M. (2000). Physiotherapy for anterior knee pain: a randomized controlled trial. *Annuals of Rheumatology Disorders, 59*, 700-704.

Coplan, J. (2002). Ballet dancer's turnout and its relationship to self-reported injury. *Journal of Orthopaedic & Sports Physical Therapy, 32*(11), 579-584.

Ellaszie, M., Young, L., Woodbury, G., Fryday-Field, K. (1994). Statistical methodology for the concurrent assessment of interrater and intrarater reliability: using goniometric measurements as an example. *Physical Therapy*, *74*(8), 777-788.

Farrar, J., Young, J., LaMoreaux, L., Werth, J., & Poole, M. (2001). Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain, 94*(2), 149-158.

Harilainen, A. (1987). Evaluation of knee instability in acute ligamentous injuries. *Ann Chair Gynaecol*, *76*(5), 269-273.

Herrington, L., Rivett, N., & Munro, S. (2006). The relationship between patella position and length of the iliotibial band as assessed using Ober's test. *Manual Therapy, 11*, 182-186.

Hurley, W., Denegar, C., & Hertel, J. (2011). Research Methods: A Framework for Evidence-Based Clinical Practice (1st ed.). Baltimore, MD: Lippincott, Williams & Wilkins.

Jaeschke, R., Singer, J., & Guyatt, G. (1989). Ascertaining the Minimal Clinically Important Difference. *Controlled Clinical Trials, 10*, 407-415.

Karachalios, T., Hantes, M., Zibis, A., Zachos, V., Karantanas, A., & Malizos, K. (2005). Diagnostic Accuracy of a New Clinical Test (The Thessaly Test) for Early Detection of Meniscal Tears. *Journal of Bone and Joint Surgery, 87-A*(5), 955-962.

Lee, T., Anzel, S., Bennett, K. (1994). The influence of fixed rotational deformities of the femur on the patellofemoral contact pressures in human cadaver knees. *Clin Orthop.,* 302, 69-74.

Lee, T., Morris, G., Csintalan, R. (2003). The influence of tibial and femoral rotation on patellofemoral contact area and pressure. *J Orthop Sports Phys Ther*, 33, 686-693.

Liporaci, R., Saad, M., Felicio, L., Baffa, A., & Grossi, D. (2013). Contribution of the Evaluation of the Clinical Signals in Patients with Patellofemoral Pain Syndrome. *Acta Ortop Bras., 21*(4), 198-201.

Magee, D. (2008). *Orthopedic Physical Assessment* (5th ed.). St. Louis, MO: Sunders Elsevier.

McConnell, J. (1986). The Management of Chondromalacia Patellae: A Long Term Solution. *The Australian Journal of Physiotherapy, 32*(4), 215-223.

McConnell, J. (2002). The physical therapist's approach to patellofemoral disorders. *Clinical Sports medicine, 21*(3), 363-387.

McConnell, J. (2007). Rehabilitation and Nonoperative Treatment of Patellar Instability. *Sports Medicine And Arthroscopy Review, 15*(2), 95-104.

Mulligan, B. (2010). *Manual Therapy: NAGs, SNAGs, MWMs, etc.* (6 ed.). Wellington, New Zealand.

Noerhen, B., Pohl, M., Sanchez, Z., Cunningham, T., & Latterman, C. (2012). Proximal and distal kinematics in female runners with patellofemoral pain. *Clinical Biomechanics, 27*, 366-371.

Norkin, C., & White, J. (2003). *Measurement of Joint Motion; A Guide to Goniometry* (3rd ed.): F.A. Davis.

Paulos, L., Rosenberg, T., Drawbert, J., Manning, J., & Abbott, P. (1987). Infrapatellar contracture syndrome. An unrecognized cause of knee stiffness with patella entrapment and patella inferas. *American Journal of Sports Medicine, 15*, 331-334.

Piriyaprasarth, P., & Morris, M. (2007). Psychometric properties of measurement tools for quantifying knee joint position and movement: A systematic review. *The Knee, 14*, 2-8.

Piva, S., Fitzgerald, K., Irrgang, J., Jones, S., Hando, B., Browder, D., & Childs, J. (2006). Reliability of measures of impairments associated with patellofemoral pain syndromes. *BMC Musculoskeletal Disorders, 7*(33).

Pool, J., Ostelo, R., Hoving, J., Bouter, L., & de Vet, H. (2007). Minimal clinically important change of the neck disability index and the numerical rating scale for patients with neck pain. *Spine, 32*(26), 3047-3051.

Powers, C., Ward, S., Fredericson, M., Guillet, M., & Shellock, F. (2003). Patellofemoral Kinematics During Weight-Bearing and Non-Weight-Bearing Knee Extensions in Persons with Lateral Subluxation of the Patella: A Preliminary Study. *Journal of Orthopaedic & Sports Physical Therapy, 33*(11), 677-685.

Puniello, M. (1993). Iliotibial Band Tightness and Medial Patellar Glide in Patients with Patellofemoral Dysfunction. *Journal of Orthopaedic & Sports Physical Therapy, 17*(3), 144-148.

Reid, D. (1988). Prevention of Hip and Knee Injuries in Ballet Dancers. *Sports Medicine, 6*, 295-307.

Stratford, P., Gill, C., Westaway, M., & Binkley, J. (1995). Assessing Disability and Change on Individual Patients: A report of a patient specific measure. *Physiotherapy Canada, 47*(4), 258-263.

Takasaki, H., Hall, T., & Jull, G. (2013). Immediate and short-term effects of Mulligan's mobilization with movement on knee pain and disability associated with knee osteoarthritis - A prospective case series. *Physiotherapy Theory & Practice, 29*(2), 87-95.

Vela, L., & Denegar, C. (2010a). The Disablement in the Physically Active Scale, Part II: The Psychometric Properties of an Outcomes Scale for Musculoskeletal Injuries. *Journal of Athletic Training, 45*(6), 630-641.

Vela, L., & Denegar, Craig. (2010b). Transient Disablement in the Phyiscally Active With Musculoskeletal Injuries, Part I: A Descriptive Model. *Journal of Athletic Training, 45*(6), 615-629.

Vicenzino, B., Hing, W., Rivett, D., & Hall, T. (2011). *Mobilisation with Movement: The art and the science*. Australia: Churchill Livingstone.

Welsh, C., Hanney, W., Podschun, L., & Kolber, M. (2010). Rehabilitation of a female dancer with patellofemoral pain syndrome: applying concepts of regional interdependence in practice. *North American Journal of Sports Physical Therapy, 5*(2), 85-97.

Wilk, K., Davies, G., Mangine, R., & Malone, T. (1998). Patellofemoral Disorders: A Classification System and Clinical Guidelines for Nonoperative Rehabilitation. *Journal of Orthopaedic & Sports Physical Therapy, 28*(5), 307-322.

Witvrouw, E., Callaghan, M., Stefanik, J., Noehren, B., Brazett-Jones, D., Willson, J., Crossley, K. (2014). Patellofemoral pain: consensus statement from the 3rd international Patellofemoral Pain Research Retreat held in Vancouver, September 2013. *British Journal Of Sports Medicine, 48*(411-414).

Appendix 1: Data Collection Sheet

Patient Name: _____ Patient ID #: _____

Date: _____ DOI: _____ Side: L / R Gender: M / F

Initial evaluation or Follow-up evaluation

MOI:

_____

_____

Pain prior to treatment: _____ /10

History:

_____

_____

_____

_____

Patient Specific Functional Scale:
Initial: I am going to ask you to identify up to three important activities that you are unable to do or are having difficulty with as a result of your _____ problem. Today, are there any activities that you are unable to do or having difficulty with because of your _____ problem?

F/U: When I assessed you on (state previous assessment date), you told me you had difficulty with (read all activities from list at a time). Today, do you still have difficulty with: (read and have patient score each item in the list).

Activity	Score				
1.					
2.					
3.					
Additional					

Observation:

_____

_____

_____

_____

Palpation:

_____
_____
_____
_____

Circulation:

_____

Neuro:

_____

ROM:

AROM:	L-Pre / L- Post	R-Pre / R-Post
Flexion		

Special Tests:

Test	Left	Right
Thssaly		
Valgus		
Varus		
Lachman's		
Ober's		
Lateral patellar tilt		
Clarke's Sign		
Medial glide		
Lateral glide		

Classification:

_____
_____

Mulligan Intevention and Pain Score:

Intervention	Pre-NPRS	Post-NPRS

DPA Scale Scores:

Date:	Score:

Reflection:

_____
_____
_____
_____