

University Honors Program

Capstone Approval Page

Capstone Title:

Examination of Upper & Lower Extremity Peripheral Joints

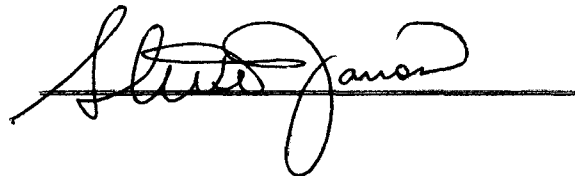
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A handwritten signature in black ink, appearing to read "Steven C. Janos", written over a horizontal line.

Department of:

Physical Therapy

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HONORS THESIS ABSTRACT

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ABSTRACT:

The aim of this project was to provide an accessible multimedia resource for Physical Therapy students enrolled in AHPT 440, Evaluation and Treatment of Musculoskeletal Disorders. Specifically, the finished product is a series of DVD's to be included as course materials to assist in preparation for practical examinations.

A clinician from the Physical Therapy Department agreed to demonstrate the techniques on camera, subjects were recruited, and studio time was booked on campus. Raw data was then loaded onto an Apple computer and edited in stages, including clip sorting, cropping, tagging, audio correction, chapter placement, and multimedia placement (including music).

The finished product has been informally noted by the professor to have facilitated excellent manual techniques in students who utilize it, at the expense of patient communication demonstration in practical exams.

As a Northern Illinois University Physical Therapy student, I am expected to be skilled in evaluation and treatment of a variety of musculoskeletal disorders and impairments. The expectations placed upon myself and my classmates are somewhat unique to our field in that we must be very academically knowledgeable, but we are also evaluated rigorously on our hands-on expertise in simulated patient-practitioner settings. The course that this project relates to is AHPT 440: Evaluation and Treatment of Musculoskeletal Disorders.

This project facilitates the advancement of future Physical Therapy students' physical examination skills. When practicing on their own time, students do not have full-time availability of a professor or clinician to demonstrate techniques repeatedly, although still photos are made available for student use. Being a second-year Physical Therapy student, I can recognize the momentous benefit of having an audio-visual aid available at any time, depicting each technique from at least one angle, complete with verbal instructions and other useful information. Students can also benefit from viewing the disc from beginning to end, uninterrupted, to develop a better understanding of the overall flow and sequencing of a thorough peripheral joint examination.

This project involved human subjects who would appear on film as mock patients. A consent form was written (appended at the end of this paper), outlining the goals of the project, what was to be expected of the subjects, possible risks involved, compensation, and protection of subjects' rights and privacy. The sole compensation offered was a free copy of the final product. Two subjects were to be selected; one to appear in the lower extremity peripheral joint examination DVD and the other to appear in the upper extremity peripheral joint examination DVD. It was thought that to avoid

monotony and to present some realistic clinical variety, one female subject and one male subject could be recruited.

Potential subjects were approached individually to solicit their involvement in the project. Some criteria considered in potential subjects are as follows:

- **Lean body build:** When a Physical Therapist is using his or her hands on a patient's body (via palpation of structures and/or usage of manual techniques) he or she is able to discern tissues from each other through a highly refined tactile sense. For distance learning purposes, individuals whose bony landmarks are visible easily to the audience are of considerable benefit. Many of the techniques outlined in the DVD are of a nature that require very specific hand placement on said bony landmarks; the correctly performed technique executed in the incorrect location is useless and/or possibly harmful.

- **Lack of pathology in the extremities to be featured in the project:** This criterion was important for two reasons. In the interest of the subject, to further protect his or her safety, any individual with pathologies or pain in an area of the body to be examined on film was excluded from consideration for the project. In a clinical situation, in which a therapist is focusing completely and intensely on a patient, he or she can determine the status of tissues via the quality of their movement and through experience in determining an 'end feel' (the unique qualitative categorization of the end of a joint or tissue's passive range of motion). A skilled therapist can predict painful ranges before the patient actually experiences pain. However, when the on-screen physical therapist is performing and explaining manual techniques for the benefit of the viewing audience, he is challenged to fully appreciate the subject's responses to the movements.

The other reason for excluding pathological subjects in the projects is to avoid demonstrating abnormal findings to an audience that could benefit more readily from seeing relatively normal subjects initially. It is recognized that no subject is completely free of some abnormality, and in fact some slight aberrations were found during the filming process that were unknown previously. These irregularities were pointed out verbally on film to ensure that viewers did not internalize what they were seeing as normal findings. Any further exploration or explanation of the newly revealed pathologies was beyond the scope of the project and therefore omitted.

- Comfort with on-camera body exposure: In addition to being included in the consent form, an up-front discussion was had with each potential subject regarding on-screen body part exposure. The subject to appear in the lower extremity DVD would have to be comfortable exposing his or her upper and lower legs within reason, while the subject to appear in the upper extremity disc would either don a bra or swim top that would be unfastened in the back for some techniques (for women), or wear nothing more than gym shorts (in the case of a male subject).

Ultimately, 4 subjects dropped out of the project (1 due to scheduling conflicts, 3 due to reluctance in on-camera body part exposure) and 2 participants agreed to and signed the consent form. The subject for the upper extremity was a 22 year old male NIU student, and the subject to appear in the lower extremity portion was a 33 year old female from another northern Illinois town.

I contacted the professor of AHPT 440, Mr. Steven Janos, regarding a cooperative effort in filming and creating a set of DVDs to assist with the above

described problem. He concurred as to the need for the discs, and plans were developed. As an orthopedic specialist, he was going to be the clinician performing the techniques in the DVD, and I would handle everything else, including the subject selection, filming, editing, etc.

In the past, Mr. Janos had been involved in similar endeavors to record his manual techniques for student use. Previous recordings, however, had been done very informally and somewhat haphazardly, using a classroom as the recording venue, with each item filmed from the same wide angle. No external sound capturing device was used, and the audio was distorted because the camera itself had to record any verbal explanations offered. When Mr. Janos would turn his back on the camera, the audio would become very faint, and when he was facing the camera, it was clear that he was elevating his voice beyond normal levels in order to be recorded by the video camera. It was decided that a professional studio setting would be most conducive to filming a clear and distraction-free set of techniques. Mr. Janos and I also agreed that the controlled lighting conditions would be advantageous and facilitate a professional-looking final product. I conducted a search of local studios and resources and decided to contact the Media Resources Department of NIU. The filming studio is located in Graham Hall, in room 143. I began a correspondence with the director of media resources, Len Lennergard. The studio at NIU is normally leased at a rate of \$60 per hour; this price included technical assistance, equipment use, lighting controls, as well as physical use of the studio space. Due to the fact that I own some semi professional recording equipment, I negotiated a reduced price of \$20 per hour, and the only equipment belonging to the studio that we were to use was the wireless microphone for Mr. Janos. The physical therapy department was more than happy to fund this

endeavor, as its students would be benefiting greatly from the completion of this project. It was determined that at the end of the filming process, a bill would be sent directly to the Physical Therapy department for payment.

The studio setup in Graham Hall suited our needs; a variety of backdrops were available, and the floor was black to avoid distracting glare. Acoustic paneling adorned the walls and ceiling, to prevent echoing and audio distortion. A track system of professional filmography lights was in place, with a comprehensive switchboard that allowed a trained individual to adjust the amount of light coming from each unit on the ceiling. There were spot lights as well as what are called wash lights, which are designed to bathe the area in soft light, with minimal shadow production. Some lights were further damped by fabric pinned over the front surface. It did prove somewhat challenging to maintain a consistent lighting setup from session to session, as I am not trained in operation of the light board and assistance was not always available (another consequence of the reduced cost to lease the studio space).

We opted to use the black background, which was pulled across the back of the filming area like a curtain. The examination table itself was draped with a black bedsheet as well, to keep everything other than the subject and the therapist as unobtrusive as possible. Interestingly, when Mr. Janos would wear a black shirt for filming, everything seemed to disappear except for his exposed arms and the mock patient. This made for a very focused view of the technique itself.

The wireless microphone that was used was a great asset; the mic itself was pinned to his lapel and a wireless unit clipped onto his belt. This transmitted to a unit which, via an adapter, entered my camera. Having such a setup created a crystal-clear audio feed, free of outside noises. The camera did not record any audio whatsoever that

did not come directly from the lapel microphone. I was also able to wear a set of studio headphones during filming, through which I heard the direct audio feed from the wireless microphone, and nothing else. Therefore, I was hearing an accurate version of what was being recorded, as it was being recorded, instead of listening to the in-room audio.

Before entering the studio, I story-boarded the filming process, planning out each shot and field of view. I realized that it would facilitate a smoother filming process if a plan was followed. Having completed the course (AHPT 440) in the past, I already had an outline of the techniques. There are, for each peripheral joint, several different categories of techniques, each with a number of specific entities. For example, in performing a thorough examination of the knee, I followed the following organization of flow:

Active Range of Motion

Flexion

Extension

Medial Rotation

Lateral Rotation

Passive Range of Motion

Flexion

Extension

Medial Rotation

Lateral Rotation

Muscle Length Testing

Modified Thomas Test

Ober's Test

Hamstring Test

Gastrocnemius Test

Accessory Motion Testing

Tibiofemoral Joint

Distraction

Compression

Anterior Glide

Posterior Glide

Medial Glide

Lateral Glide

Patellofemoral Joint

Distraction

Compression

Cephalic Glide

Caudal Glide

Medial Glide

Lateral Glide

Special Tests

Observation

Patella Alta, Patella Baja, Patella Tilt

Q-Angle

Varus & Valgus Stress Testing

Anterior & Posterior Drawer Testing

Lachman's Test

Pivot Shift Test

Apley's Test

McMurray's Test

Wilson Test

Swelling Assessment

Fluctuation Test

Patellar Tap Test

Circumferential Measurement

Leg Length Testing

Patellofemoral compression tracking

Combined Movement Testing

Extension/Abduction

Extension/Adduction

Flexion/Abduction/Medial Rotation

Flexion/Adduction/Lateral Rotation

For each test, I made a note of what angle(s) it would best be filmed from. Some of these plans were discarded once we arrived at the studio, however. When the actual subject was on the examination table it became clear what views would be acceptable and what views would not show adequate detail.

I also planned which techniques would be the best candidates for additional demonstration on a model or skeleton. For example, one kind of test performed in a peripheral joint examination is an accessory test. An accessory movement differs from

what is called a physiological movement in the following manner; when one flexes his or her elbow, the physiological movement occurring is elbow joint flexion. At the same time, that gross movement is composed of several accessory movements, which are smaller in scale but just as important when dealing with pathologies and overall joint function. To test these accessory movements, the joint is placed in what is called a "loose-packed position", the position at which the joint capsule and soft tissues about a synovial joint are most on slack, and the greatest amount of separation is possible between the joint surfaces. This position is unique and distinct for each of the body's joints. From this position, the joint surfaces are pulled open (distraction), pressed together (compression), and glides in every direction are evaluated as well.

As these accessory movements are most apparent at the skeletal level, and require very specific hand placement, they were excellent candidates for additional demonstration and description on the skeletal models. Mr. Janos was able to very specifically describe and demonstrate exact hand placements on the model, performing the technique one more time. As part of the story-boarding process, I aimed to have the skeletal model positioned in the same manner and orientation as the human subject; this would facilitate impressive scene transitions in which a cross-fade would seem to strip the concealing soft tissues away from a joint, leaving the skeleton visible for one more, very detailed run-through of the test.

Some pieces of examination equipment were transported across campus from the physical therapy classrooms to the studio with the assistance of Meri Goehring, another faculty member in the Physical Therapy department. The equipment transported included one examination table, a rolling stool, a stepstool, four pillows, linens

(including pillows, towels, and sheets), and plastic models of the extremities. This equipment was left in the studio for several months' duration of filming.

Raw footage was stored on MiniDV tapes, labeled, and set aside for post-production editing. When filming was completed in the summer of 2006, the raw footage was imported via a Firewire cable onto an Apple PowerMac G5 computer running the OS X operating system. A separate hard drive was purchased and installed specifically to house the large amounts of video data that would be inherently necessary through the completion of the project. The software suite utilized to edit and create the DVD was part of the iLife 2006 suite, specifically iMovie and iDVD. Additionally, a software application called Garageband was used for the recording and arranging of original music in later stages of post-production.

The first step in postproduction editing involved the viewing of each clip of footage and sorting out clips that were deemed unusable. Some of the discarded clips contained verbal errors on the part of the clinician, and others were re-shot and replaced because of technical mistakes or lighting imperfections. The remaining clips were organized in a sequential fashion using the iMovie application. Each clip of footage was again viewed, with the intention of cropping the footage so that extra lead-in or trailing footage was trimmed away, leaving discrete pieces of film including just one technique. It was helpful to leave several seconds of content at each end of each segment, in which no information is being demonstrated. These small "edge" pieces empowered me to make smoother, more consistent transitions in a later phase of editing.

At this time, a digital tag was appended to every clip, denoting the name of the technique it depicted. Some segments contained more than one examination technique, in cases for which the flow was more important than discrete techniques.

Upon completion of that phase of editing, I opened each video clip one at a time and used an iMovie extractor to convert the audio from mono format to stereo. The wireless microphone at the studio, in communication with my camera through the adaptor, had only recorded audio in the right channel. To rectify this, I essentially split the right channel in half, renamed it as "center", and assigned half of the mono feed to run through the newly appointed right channel and half through the left channel independently. This audio arrangement ultimately proved to facilitate very focused, crisp audio feed, since it represents the exact same recording played on each side. Once each audio track was converted, I exported the updated version of each clip to a new folder on the hard drive from which iMovie would draw theretofore.

The next phase involved scene transitions. After experimenting with and modifying different available transitions, I decided that a systematic approach would help the students keep track of the different sections of the examination. Even if the viewer does not cognitively realize it, they may have an easier time understanding when a new portion or category of techniques has begun. For example, every time a new broad category of techniques is initiated, a scene transition called a "Scale Down" is presented. This occurs when passive range of motion assessments have been completed and the therapist is moving on to muscle length tests, when accessory movement testing has been completed and special tests ensue, etc. At the next level, every time a new individual technique begins, and between scenes involving demonstrations of the same technique, a scene transition called a "Cross Fade" is enacted. This is a less drastic

transition that aids in moving from one item to the next smoothly, but without as much visual disruption as is the case in the “Scale Down” transition. Similarly, every time that a transition is made from a human subject to a skeletal model or from a skeletal model back to a human subject, I placed a “Ripple” transition. This sweeping changeover is just another way to help the viewer mentally organize him or herself as to what is going on. As mentioned above, in many cases, the model was filmed in the same position and at the same zoom level such that it seemed as if the skeleton was suddenly visible in the recently-removed context of the surrounding soft tissues. While all Physical Therapy students are well educated in anatomy and structural physiology of the joints, it is still helpful to use such measures to help him or her stay oriented to the image on the television screen, especially when an up-close view is involved.

Upon completion of the transitions editing, my next step involved the placement of chapter markers. These digital placeholders were positioned at the advent of each technique. In some cases, as discussed previously, several tests or techniques were included within one chapter. It was my goal to ensure that a student, upon experiencing confusion or difficulty with a specific task, could skip directly to that chapter without having to fast-forward or seek through footage to find what he or she needed clarification on. It would have been possible, however, to have almost 60 chapters on each of the upper and lower extremity portions. I decided that this many chapters would be excessive, and therefore prioritized the final chapter markers. Some techniques flow very smoothly and logically from one to the next. For example, in performing the accessory movements of the tibiofemoral joint, once a student has successfully completed the anterior glide, he or she can change hand placement and body positioning only slightly to move directly (and efficiently) onward to the posterior

glide. Rather than breaking up the techniques into separate chapters, I opted to allow several to occupy a single chapter marker.

On the other hand, I decided to give each Special Test its own chapter. These tests are relatively free-standing techniques that do not necessarily follow a sequence. They are also, in many cases, technically difficult to perform. Therefore, each one has its own chapter so students can easily seek out the technique(s) with which they need assistance.

The last step taken within the iMovie phase of post-production involved detailed audio scrutiny as well as subsequent editing. I layered a Master Track for the audio feed, which I was able to adjust higher or lower at very detailed increments. There were several instances, due to the nature of the techniques, where the patient is either pressed against or moving against Mr. Janos' microphone, causing rustling and scratching sounds. I was able to isolate these instances and remove the extraneous noise. There were a few occasions where the therapist used vocalized pauses, and I was able to segregate and eliminate these as well. I listened to each scene transition an extra time, to be sure that the volume of Mr. Janos' voice was the same at the beginning of each clip as at the end of its predecessor. Sometimes, with the introduction of a new topic, he would inadvertently elevate the volume of his voice and very gradually taper off throughout the segment. Through prolonged and gradual modulation of the master audio track, these variances were also made undistinguishable.

It was at this time that the entire iMovie project file was shared with the iDVD application. This is where the DVD itself was created; iMovie was the tool I used to create and edit the footage, and iDVD was where I created the visual format one is presented with upon loading the disc in their DVD player.

Within the iDVD software, I began by designing the background and placing the various menu buttons and drop zones. A drop zone is a region of the menu into which a video, slide show, or still frame can be displayed. A separate screen allowed me to view the entire project as a branching tree, wherein I was able to arrange menus, submenu, headings, etc.

Next, each chapter (containing one or more techniques) needed to be labeled and placed; an appropriate still frame was to be selected to give a snapshot view of each technique, visible from the chapter menu. It was hoped that just seeing the snapshot views repeatedly, as students navigated the DVD menu, would bolster their learning of the techniques. This is especially true with regards to recalling general patient position. A student may have difficulty recalling whether the patient is to be supine, sidelying, or prone for a given technique. Visual learners can well benefit from the visual trace left by these snapshots alone.

The last step in post-production editing was a personal touch; I opted to perform and record original music that would play in the DVD's various menus. I used a 66-key M-Audio Keystation 61eS, communicating with the PowerMac G5 via a universal serial bus. In previous production endeavors, I had composed and recorded completely original works, however for this project I decided to perform selections from the Toccata & Fugue in G Minor by Johann Sebastian Bach. I chose 4 small clips from the piece, which was originally written for the pipe organ, and adapted each one to be suited by a different instrument; Steinway piano, church organ, grand piano, & 12-string guitar.

The finished product, mastered on the same G5 machine, was to be mass-produced for student distribution as a course material recommended by Steve Janos in his classes. Approximately 100 of each disc were to be replicated, labeled, and outfitted

with a plastic case. To accomplish this duplication from the master discs, I used a disc duplicator that could accommodate and burn 8 DVD's simultaneously, requiring approximately 20 minutes per each 8 discs.

Mr. Janos designed, printed, and applied the labels, using the Avery CD/DVD Labeling System. The labels included the content topic, reference to NIU, and credits to Mr. Janos and myself.

The impact that this project has had on student learning and performance is difficult to assess; Mr. Janos has taught here at NIU for just 2 and a half semesters and in that time, there has been scant opportunity to compare student performance on his exams before and after introduction of the DVD's. It has been informally noted, however, that students' technical skills seem to have been greatly improved secondary to the DVD distribution. The students have required fewer repetitive in-class and out of class re-demonstrations of techniques. On the other hand, he noted that one key element of a patient examination has been lacking in the students who have used my supplemental learning tool; that of patient communication and interaction. It seems as if anything that is not included or explained on the DVD, the students often neglect to demonstrate during their practical exams. These items include patient instructions, patient positioning, integration of findings into problem solving and critical thinking, etc.

Overall, this has been a very enriching experience for me as a producer of this series of DVD's. I have gained a more firmly established knowledge regarding performance of the involved examinations due to my involvement in this endeavor. The Physical Therapy faculty here at NIU shares my belief that student learning in years to

come will be augmented, despite some less favorable, unforeseen consequences that have been noted in only one generation of students.

CONSENT FORM
Examination of the Peripheral Joints – DVD Production

You are invited to participate in the production of a video of examination of the pelvis and spine. You were selected as a possible participant because of your body type and availability. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This video is being produced by Sarah Habben, SPT; and Steven C. Janos, PT, MS, OCS. It is funded by the Physical Therapy Department.

Study Purpose

The purpose of the study is to clarify and demonstrate manual techniques for current and future physical therapy students.

Study Procedures

If you agree to participate in this study, we would ask you to do the following: Spend required time in the recording studio on campus, being examined on-camera by Steven C. Janos, an Orthopaedic Clinical Specialist in Physical Therapy.

Risks of Study Participation

The study has the following risks: Participants will be partially undressed in the video, exposing the entire back and parts of the pelvis. Their spine and pelvic joints will be stressed and manipulated in the examination, posing minimal risk of injury and/or pain.

Benefits of Study Participation

The benefits to study participation are: Advance familiarity with the included techniques

Alternatives to Study Participation

None

Study Costs/Compensation

No costs will be incurred by participants, and no monetary compensation will be offered.

Research Related Injury

In the event that this research activity results in an injury, treatment will be available, including first aid, emergency treatment and follow-up care as needed. Care for such injuries will be billed in the ordinary manner to you or your insurance company. If you think that you have suffered a research related injury, let the study clinician know right away.

Confidentiality

The personally identifying information of this study will be kept private. In any publications or presentations, we will not include any information that will make it possible to identify you as a subject.

Protected Health Information (PHI)

Your PHI created or received for the purposes of this study is protected under the federal regulation known as HIPAA.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision whether or not to participate in this study will not affect your current or future relations with the University or Physical Therapy Program. If you decide to participate, you are free to withdraw at any time without affecting those relationships.

Contacts and Questions

The researcher conducting this study is Sarah J Habben. You may ask any questions you have now, or if you have questions later, **you are encouraged to contact her at:**

(815) 441-4083
Sarah.habben@gmail.com

You will be given a copy of this form to keep for your records.

Statement of Consent

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature of
Subject _____
Date _____

Signature of Investigator _____
Date _____