



THE COLLEGE  
OF PEDORTHICS  
OF CANADA

# Study Guide Workbook 2

Pathomechanics, Conditions  
& Diseases



# The College Of Pedorthics Of Canada

The College of Pedorthics of Canada is a national self regulatory body whose primary purpose is to protect the Canadian public who receive foot-related services from Canadian Certified Pedorthists.

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We ensure that certified members are accountable to the highest standards of practice through our certification of members and facilities, the monitoring of continued competency and the enforcement of ethical conduct.

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## RATIONALE

What is the purpose of this learning material?

This workbook will help learners to work through various concepts, theories and constructs that are fundamental to critical thinking and problem solving skills as they apply to pedorthic assessment and treatment. You can use this workbook as a guide for discussion with your mentor, to help encourage careful consideration of pathomechanics while in the workplace, apprenticeship or practicum. Working through the various exercises and case studies will help prepare pedorthic students for the Canadian pedorthic certification exams.

## LEARNING OBJECTIVES

1. Define pathomechanical concepts relative to deformity and the potential conditions that are caused by deformities, to determine appropriate treatment options.
2. Identify the six phases of gait and how potential abnormal motion may be present within each phase.
3. Describe the causes of common gait compensations and what the treatment options are for the various conditions.
4. Reinforce an assessment process that considers the whole patient, to help develop appropriate treatment and preventative options.
5. Characterize the purpose and relevance of various functional tests that can be used for patient assessment.

## LEARNING OUTCOMES

When you complete this module you will be able to...

Utilize various techniques and processes that can help assess the pathomechanics of populations seen by pedorthists in order to inform decision making when developing patient treatment options.

# INTRODUCTION

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Pathomechanics is a large part of Pedorthics and what we do every day. This workbook will aid you in taking the concepts you have already learned, making appropriate connections between concepts and applying them in a clinical setting.

We always need to look at the patient as a whole. Throughout your assessment you can use the charts contained in this workbook as a guide to ensure you have thoroughly covered every aspect of pathomechanics and what that means for your patient.

This workbook is also an excellent guide for you to use throughout your placement or apprenticeship, with your supervisor, to promote an interactive, effective learning experience. If there are areas where you need clarity you are urged to reach out to your supervisor and work through any areas of concern or confusion. You may want to seek out several opinions to broaden your learning experience.

We are assuming you have a certain level of previous knowledge, so the charts included in this unit obviously will not cover every detail of pathomechanics. The charts can be used in several ways and can be combined to provide more information for complex cases. As you're learning and honing your assessment and clinical skills you may need help filling in the blanks to be able to effectively build a treatment plan. *The case studies are designed to help you apply your knowledge to different cases with varying complexities. This workbook provides some guidelines to help you as you develop your treatment goals and designs.*

## KEY CONCEPTS

- Link deformities to potential conditions, what you may see during your biomechanical assessment and gait analysis, potential treatment options.
- You have identified abnormal motions during each phase of gait, now look at the potential compensations you may find during your assessment, then link possible treatment to those findings.
- Classify patients into groups with common disorders or diseases. During your assessment choose the chart that is most fitting for your patient (ie., adult or athlete) and use it to help you through your assessment to determine a treatment plan.
- Think about how you would treat a patient who has plantar fasciitis, now think about how you would treat this same person if they are also diabetic. Do you change anything? Do everything the same as before? This is how we can treat a patient as a whole!



OBJECTIVE ONE

# Pathomechanical Concepts

When you complete this objective you will be able to...

Define pathomechanical concepts relative to deformities, and the potential conditions that are caused by deformities to determine appropriate treatment options.

†NOTE:

For acronyms used in this workbook please see the glossary at the end of this workbook.

**LEARNING MATERIAL**

The first chart in this unit (Chart #1) is meant as a guideline. It is not an exhaustive list of every compensation, condition and treatment related to a deformity, however, it will give you a good understanding of what may happen and will allow you to apply this knowledge with previously learned information to a patient assessment. If you are presented with a complex patient case, this chart will give you a starting point, a framework, and a way to add concepts together in order to look at the patient more holistically and come up with a pedorthic treatment plan.

The point of this exercise is to encourage you to think critically and to help you be successful in what you do. It's a support tool to help you rule in or rule out certain things with the information you have at hand.

There are multiple ways you can use Chart 1, depending on the information at your fingertips during your assessment. If you know the patient has plantar fasciitis, you can begin with the condition column and look for the associated deformities and gait compensations throughout the rest of your assessment. Conversely, if you don't know the condition but found a deformity, start there and work your way across the chart! Same goes for gait compensations...while you're learning you may have difficulty seeing something at first, but as you learn to link concepts and create a more complete picture of what may be happening you will be less likely to miss things.

For example: If you didn't find a deformity, the patient has medial longitudinal arch (MLA) pain, but during gait you've noticed prolonged rearfoot pronation – what do you do? Do they have plantar fasciitis? Do they have posterior tibial tendon dysfunction (PTTD, also called adult acquired flatfoot)? Do they have a forefoot varus that was missed? This chart and study guide will help you to keep an open mind throughout your assessment so you can ask yourself these sorts of questions then come up with a treatment plan for the whole patient, not just their plantar fasciitis!



**Exercise 1.1**

**Link Your Assessment: Deformity, Disorder & Compensations – does it all add up.**

Open up Chart #1 above by double clicking on the picture. Take a look at each of the columns and the information presented there. Examine the various correlations. Print out the chart as a separate document as we will be using this chart to solve a few case studies or questions in the upcoming practice exercises. This chart will help you to correlate important concepts and when considering patient conditions and potential pathomechanical issues.

**Questions**

1. A patient presents with a forefoot varus during your non-weight bearing evaluation. Using the chart above, answer the following questions to the best of your knowledge.
  - a. What are other possible ROM findings?
  - b. What does their potential gait look like in each phase?
  - c. What may their primary, secondary and tertiary complaints be?
  - d. What is your treatment plan for this patient?

2. A patient presents with medial knee OA. Using the chart above, answer the following questions to the best of your knowledge.
  - a. What possible WB\* findings may you see that could lead to a condition like this?
  - b. What gait compensations could be occurring in this patient?
  - c. What is your treatment plan for this patient?
3. A patient presents with an abductory twist during heel lift phase of their gait analysis.
  - a. What possible NWB\* findings may you find?
  - b. What may you expect to see during the WB\* assessment?
  - c. What gait compensations may you see during the gait assessment?
  - d. What would you do to address this in your treatment plan?



## CASE STUDY ANALYSIS



### ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart 1.1 to your mentor.
- Ask your mentor to take a few minutes to look over the chart
- Ask their opinion as to what would they change about the chart (if anything) and why?
- Ask if any patient profiles come to mind and if they can briefly describe the profile and the outcome.

### Exercise 1.2

## Complete a Case Study Analysis

A 60-year-old woman, who is working full time as a teacher, comes to your office and complains of R plantar heel pain. It's been happening on and off for a number of years (more than 10), but the pain has been an 8-10 on a pain scale for the last 6 months.

She has sharp pain out of bed first thing in the morning, aching pain through the day at work but gets worse by the end of the day. More recently, she has also been experiencing R lateral ankle pain and swelling by the end of the day.

She describes the aching through her plantar heel and medial arch. She stands and walks around her classroom most of the day with little time to sit.

### Patient Information & History

- No medical conditions
- No previous surgeries but she badly sprained her R ankle many years ago in university (she was on crutches for 4 weeks)
- She works a lot and doesn't do any other activity outside of work mainly due to the pain she's experiencing all day
- She is wearing slip on flats all day at work and no shoes in the house. She's open to shoe recommendations
- NWB\*: L normal ROM through RF, MF and STJ – no noticeable deformities or callusing, no hallux limitations
- NWB: R limited RF inversion, excessive RF eversion, limited ankle dorsiflexion, limited MF eversion, excessive MF inversion, FHL, hypermobile first ray, no noticeable deformities, callusing along the medial 1st MTPJ and IP of hallux, R hallux valgus
- WB: L RF Normal, R RF valgus, R forefoot abducted, R>L flexible pes planus, mild genu valgum is present

Gait:

- HS\* – L normal lateral, R medial and low
- LR – L normal pronation, R excessive pronation

- MS – R>>L excessive pronation, R excessive tibial internal rotation
- HL – L normal, R prolonged pronation and early heel lift
- TO – L normal, R medial
- SW – L normal, R abducted

Treatment: Continue use of current shoes with a dress orthotic made with a 3mm subortholen shell, ¾ length, RF medial post R with metatarsal pad and leather topcover.

### Using Chart #1 To Answer The Following Questions

- Is there anything that was possibly missed in the NWB\* part of this assessment?
- What condition(s) do you think she is presenting with?
- Do you feel the above treatment will be effective for this patient? Yes or no and explain why and what you would do differently.
- Were all aspects of this patient's contributing biomechanics considered in the assessment and treatment? What would you do the same or differently to ensure this?

OBJECTIVE TWO

# Gait & Motion

When you complete this objective you will be able to...

Identify the six phases of gait and how potential abnormal motion may be present within each phase.

**LEARNING MATERIAL**

This chart is very straight forward. You will see the pathomechanics that can occur during each phase of gait. Use this chart during your placement to ensure you can identify each abnormality within each phase of gait. Once you've identified each of them during your patient assessments we can build upon this knowledge to integrate assessment findings more effectively to better inform treatment options.

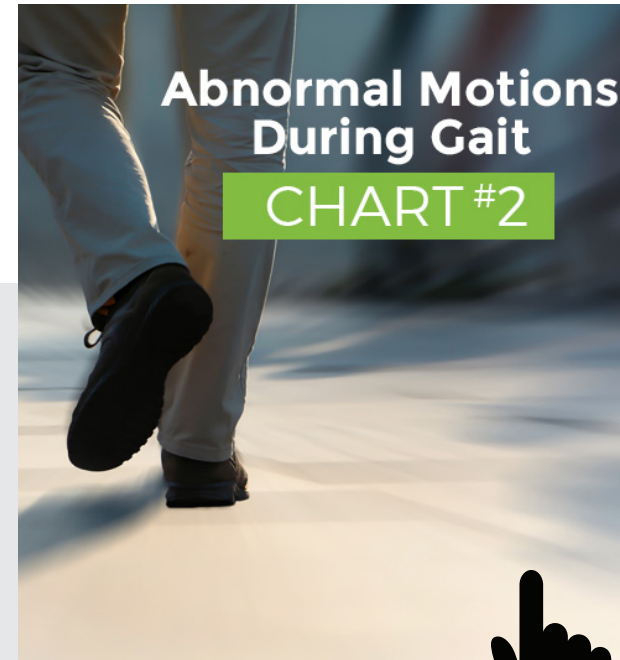
The objective here is to help you identify abnormalities in each phase of gait, and then anticipate how an abnormality in one phase may affect the next phase, linking the phases of gait during your gait analysis. For example, if you see a medial toe off what happens through swing and how does that affect heel strike? If the toe off is medial, what position is the forefoot in at toe off and therefore what is happening at the rearfoot? During swing we may see rearfoot pronation and forefoot abduction continue to occur. If this is happening through swing, can your patient have a "normal lateral heel strike"? Can their rearfoot invert in that short period of time in order to achieve the normal heel strike? What muscle(s) are actively working to make this happen?

These are the questions you want to ask yourself so you can be sure what you're seeing makes sense! If you don't identify the correct abnormalities in each phase, you may miss something and it may affect your treatment plan.

Phases of Gait:

- Heel Strike
- Loading Response
- Midstance
- Heel Lift
- Toe Off
- Swing

†NOTE:  
*Abnormalities for each of the above phases*



**Exercise 2.1**

**Abnormal Motions During Gait**

Open up chart #2 above by double clicking on the icon. Take a look at each of the columns and the information presented there. Examine the various correlations. Print out the chart as a separate document as we will be using this chart to solve a few case studies in the upcoming practice exercises. This chart will help you to correlate important concepts when considering patient conditions and potential pathomechanic issues.

**Exercise 2.2**

**Complete Video Case Study**

Watch this sample video (see link below) of someone walking with abnormal motions and use the chart to conduct the assessment.

1. Name each of the abnormal mechanics you see in each phase of gait and don't forget to comment on the R and L side.
  - a. Heel Strike
  - b. Loading Response
  - c. Midstance
  - d. Heel Lift
  - e. Toe Off
  - f. Swing

Please follow the links below to access the videos:

- Exercise 2.2 Video A  
Frontal: <https://youtu.be/zNz1HR289pM>
- Exercise 2.2 Video B  
Transverse: <https://youtu.be/9MloAK9YDOU>

1. What is the best treatment option for the patient in this case? Explain.
2. Based only on what you see, what condition do you think the patient in this video may have? Deformities?

## ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Watch the above YouTube videos with your mentor and ask their opinion and how they would describe the abnormalities and what their treatment plan would be.

OBJECTIVE THREE

# Gait Compensations

When you complete this objective you will be able to...

Describe the causes of common gait compensations and what the treatment options are for the various conditions or visible compensations.

**NOTE:**

Chart #3 builds from the chart in objective 2, the numbers correlate back to that chart. The letters correlate to each other (ie. 1.a. RF Valgus – next column a. is the treatment for

**LEARNING MATERIAL**

Now that you can pick out what an excessive lateral heel strike is, what's next? What's causing it? How do you fix it?

During the assessment with your patient, you have completed the following sections:

- Non weight-bearing assessment
- Weight-bearing assessment
- Gait analysis

You should be able to link your findings from the 3 sections listed above to build an appropriate treatment plan for your patient.

Let's look at a specific example. Say for example, during your NWB\* assessment you've found a hypermobile first ray. You should have some ideas of what you may see during your WB assessment as well as your gait analysis that are caused by the hypermobile 1st ray:

- Non weight-bearing = hypermobile 1st ray
- Weight-bearing = excessive rearfoot pronation
- Gait analysis = prolonged rearfoot pronation, medial toe off

Once you complete the assessment you will be able to confirm that what you've found does link back to the hypermobile 1st ray and your findings all correlate with each other.



**Exercise 3.1**

Open up the chart #3 to the left by double clicking on the icon. Take a look at each of the columns and the information presented there. Examine the various correlations. Print out the chart as a separate document as we will be using this chart to solve a few case studies in the upcoming practice exercises. This chart will help you to correlate important concepts and when considering patient conditions and potential pathomechanical issues.

**Look at the chart... Can you answer the following questions?**

- With what compensations would you choose to add heel lifts? Why?
- What compensations would you expect to see with the short limb in a LLD\*?
- What abnormal motions can be caused by a FF\* varus?
- Why may a delayed heel lift occur? What do you do about it in your treatment plan?

You can also look at it from the other end. Let's say in the assessment above you missed the hypermobile first ray, but you found the following;

- Non weight-bearing = did not test first ray ROM
- Weight-bearing = excessive rearfoot pronation
- Gait analysis = prolonged rearfoot pronation, medial toe off

So, what's causing the prolonged pronation and medial toe off? Now you can go back to your NWB assessment and double check to see if anything was missed. This organized progress through the assessment, trying to link together findings, will help you not only perform a more complete assessment but also help develop an appropriate treatment plan that best suits your patient.

**Now it's time to create your treatment plan! Remember this is not an exhaustive list for compensations or treatment, so if you think there's another treatment option, and you can justify its use, go for it!**

## CASE STUDY ANALYSIS



### ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart 3.1 to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they have any other treatment ideas that are not listed on the chart and why/when they would use them.
- Ask if they can review an area of the chart that you feel you're weak in and discuss a patient case that relates to that section and the outcome.

### Exercise 3.1

## Complete a Case Study Analysis

A 55-year-old man, who works full time in a retail store, comes into your office and complains of hip and knee pain. He says it's getting worse and worse over time. The main thing that brought him in is a few recent falls that have him worried about the next fall. He has peripheral neuropathy, so he has no sensation from below his knees.

He has to wear steel toe work boots at work and does a variety of activities like standing, walking, bending, squatting, lifting and climbing stairs. He describes his knee and hip pain as aching that gets worse by the end of his workday, but little to no pain on the weekends when he can sit more. No morning pain.

### Patient Information & History

- No previous surgeries, but he has sprained his R ankle many times over the years
- He is on his feet for the full 8 hours at work and tries to stay off them other than doing daily activities of living
- He doesn't always wear shoes around the house (which is where the falls have taken place)
- NWB\*: R>L limited to no RF eversion, RF inversion is excessive in comparison but would fall within normal limits, Pes equinus bilaterally, limited MF ROM in dorsiflexion and inversion/eversion, L rigid PF 1st ray, R rigid FF valgus, claw toes 1-5, dropped transverse arch, all digits including hallux sit raised off the ground, callusing around heel and lateral foot and along all met heads, corn on the dorsal IP joint of hallux bilaterally
- WB\*: R>L RF Varus, genu varum, tibial varum, rigid pes cavus, knees are externally rotated and flexed and hips are slightly flexed (forward trunk lean)

Gait: excessive tibial and femoral external rotation, Foot slap, R>L supination, excessive lateral heel strike, High steppage, bilateral delayed heel lift, continued excessive tibial and femoral external rotation, bilateral flatfoot strike, bilateral low gear push off, knees also externally rotated

### Using Chart #3 To Answer The Following Questions

Match the abnormal motion occurring in the above case study to the phase of gait it occurs in:

- Heel Strike
- Loading Response
- Midstance
- Heel Lift
- Toe Off
- Swing

- What are the potential causes of each gait compensation (abnormal motion)?
- Which compensation(s) do you believe is (are) causing his hip and knee pain?
- What treatment plan would you suggest for this patient?



OBJECTIVE FOUR

# Treatment & Prevention

When you complete this objective you will be able to...

Identify the assessment process to help offer treatment and preventative options by treating the patient as a whole.

**NOTE:**

Again this isn't an exhaustive list, so use the information provided in combination with the information you've obtained from your patient and build on it as needed.

**LEARNING MATERIAL**

The goal of this objective is to focus on the whole patient. As you get more experienced and comfortable and see plantar fasciitis a million times, it's easy to focus on the plantar fasciitis and not look up the kinetic chain to see what else may be going on that is contributing to the problem.

What happens if they have plantar fasciitis but they also have PTTD\*? Or also have diabetes? Do you look at the plantar fasciitis only? Do you take into account everything you've found during your assessment? Does your treatment plan change?

There are seven charts in this objective which describe common conditions and diseases and are divided into the following categories:

- Children
- Adults & Elderly
- Athletes
- Neurological
- Disability
- Diabetes

Arthritis

Based on your patient you can utilize the specific chart that best matches their needs. We again link multiple factors to get the most out of this learning exercise. Does your assessment vary depending on the classification of the patient you're seeing? (ie. kids vs adults, athletes vs diabetics)?

You can use these charts in a variety of ways ...if you're not sure of the disorder your client has, you can start in signs and symptoms and work your way back, or work forward from a specific condition into treatment options! It will take you through your assessment, touching on; history, signs and symptoms, possible progression, potential treatment and important considerations. Functional testing will be covered in the next objective.

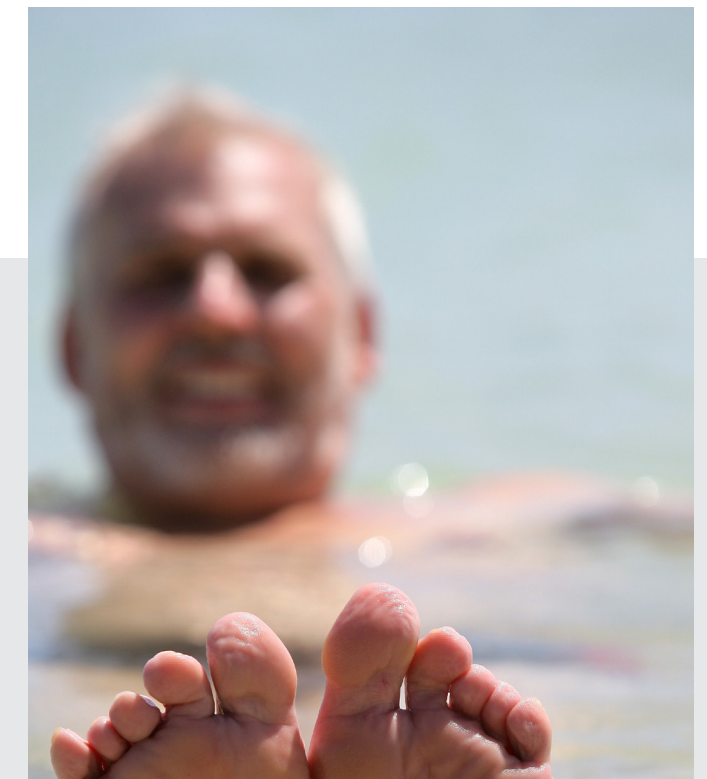
**Exercise 4.1**

**Preventative Approach to Diseases and Conditions**

Open up the charts and checklists below by double clicking on the icon. Take a look at each of the columns and the information presented there. These charts will help you to correlate important concepts when considering patient conditions and potential pathomechanical issues. Print out each chart as a separate document as we will be using these charts to solve a few case studies in the upcoming practice exercises.

**Assessment Checklist**

Here's a review assessment checklist that you can use as you're going through assessments at your placement to ensure you've captured all the needed information to create a successful treatment plan for your patient.



## TREATMENT & PREVENTION

### Preventative Approach to Diseases & Conditions - Charts

4a



CHILDREN

4b



ADULTS & ELDERLY

4c



ATHLETES

Involve them in the conversation (age dependant) don't just talk to the parent. Get them to show you where it hurts, they will be able to point better than describe. It can be difficult getting kids to walk "normally" sometimes, asking them to run or to hold something while walking, it will get them focusing on something other than you watching them walk (ie. ask them to walk down the hallway and close the first office door, or retrieve a particular book or object for you).

When doing functional tests or casting, involve them in the process, describe what you're doing and how they can be a big helper, it will help you get better results! If you can get them excited or interested in how you're going to help them, they'll be more likely to follow your treatment plan.

When assessing patients who bring in family, ensure you still speak and look directly at the patient, even if they look to their family to help answer questions, keep them involved (may be due to hearing difficulties or language barriers). When assessing a patient with an interpreter, make sure you address the patient at all times, not the interpreter.

Check your grip and touch with patients, especially the elderly who have thinner skin and less fatty tissue, or those who may be sensitive. When doing functional testing ask the patient if they're comfortable doing the test.

Choose casting that won't put undue stress on the patient (i.e. chose wax or plaster casting if it will hurt to push their foot into a foam box).

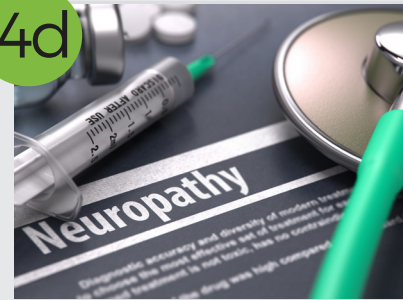
Keep in mind that sport specific athletes may have muscle imbalances due to their sport (ie. Butterfly swimmer) Their goals for treatment will likely be sport specific as well, may not be pain free but return to activity.

Athletes can usually isolate their muscles, whereas sedentary people can't always, so they will be able to do more testing and more or different strengthening exercises than others may be able to.

CONSIDERATIONS

### Neurological & Other Considerations

4d



NEUROLOGICAL

4e



DISABILITIES

4f



DIABETES

4g



ARTHRITIS

CONSIDERATIONS

Regardless of the type of arthritis they have, limited hip ROM and using their hands may be difficult so consider that while developing your treatment plan (ie. Laces may be hard to do up so Velcro could be a better option or elastic laces, or maybe they need a long handled shoe horn to help don their shoes). Joint movement may be painful, or they may be sensitive during your hands-on assessment.

This will vary based on their disease. They may be highly sensitive to touch and pain or they may not be able to feel at all, or they may have some form of paralysis, be sensitive to this throughout your assessment.

They may have high or low muscle tone which will affect their ROM. If they have any trouble communicating be sure to involve them in the assessment even if you're getting information from their family or support worker. Testing may be difficult depending on the situation so avoid if possible.

Look for any pressure areas and always consider offloading as your goal.

Understand that they may have things going on in their life that are more important than the state of their feet (we think their feet should be most important but a roof over their head may be on the top of their list). Point is, work within their means and make sure they are a part of the treatment plan vs telling them what they have to do (i.e. lose weight, exercise more, buy new shoes etc...).

PATIENT PROFILE CASE STUDY | **Children**

**Exercise 4.2**



**Complete a Case Study Analysis**

A 10-year-old boy is referred to your office for R heel pain. It started in the summer when he was playing soccer and isn't going away with hockey tryouts right around the corner. His parents are wondering if he should go to his tryouts, or if he needs to sit out this year?

He has pain during activity which is gone with rest. He points to the back and bottom of his heel to describe where the pain is.

His Rx says plantar fasciitis but has no morning pain.

**Patient Information & History**

- No medical conditions
- No previous surgeries or injuries
- He played soccer all summer and is running cross county and trying out for a competitive hockey team
- He wears running shoes all the time, cleats for soccer and nothing in the house
- NWB\*: Bil hypermobile ROM through RF and MF, very limited in ankle dorsiflexion, normal hallux ROM, no callusing or deformities
- WB: Bil RF valgus (mild), everything else appears normal

**Gait:**

- HS – Bil central/medial and low (almost flat foot strike)
- LR – Bil excessive rearfoot pronation
- MS – Bil excessive rearfoot and midtarsal pronation
- HL – Bil very early heel lift – “bouncy” gait
- TO – Bil normal
- SW – Bil low ground clearance but otherwise normal

**Use Chart #4a To Answer The Following Questions**

- What condition do you think he has?
- What's the progression of this condition and what is your recommendation to his parents in regards to hockey?
- What's your treatment plan? Explain
- What do you do differently during your assessment because he's a child?

**ASK YOUR MENTOR**

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

PATIENT PROFILE CASE STUDY | **Adults & Elderly I**

**Exercise 4.3**



4b



**ASK YOUR MENTOR**

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

**Complete a Case Study Analysis**

A 28-year-old women, who is working full time as a graphic designer, comes into your office and complains of L>R plantar foot pain and medial MLA pain. Onset is recent (1 month) and pain scale is about a 2 out of 10. The reason for her visit is because she was running 5 times a week about 30 km total and she can't do that anymore because her L foot bothers her.

She has aching pain mainly with running, but over the last week started through the day at work getting worse by the end of the day.

She works at a standing desk most of the day. Does get some back pain throughout the day (worse with sitting).

**Patient Information & History**

- No medical conditions
- No previous surgeries but has sprained L ankle many times over the years
- Was running 5x/wk, currently has stopped due to discomfort
- She is wearing slip on flats or dress boots all day at work and no shoes in the house
- NWB\*: Bil hypermobile RF ROM, and hypermobile 1st ray, R hypermobile MF ROM, L limited eversion and excessive in version, L>R limited RF DF, Bil FHL, L callus plantar IP jt of hallux, mild clawing of digits 2-5
- WB: L>R flexible pes planus, L RF valgus, R RF normal, knees, tibia are normal
- HL – L prolonged pronation and L limited heel lift, L>>R abductory twist
- TO – R normal, L off the plantar medial hallux, major abduction of L
- SW –L abducted but then circumducts to bring foot straight for heel strike, R mild circumduction – bilateral very low ground clearance

**Gait:**

- HS – L> R medial and low
- LR – L>R excessive rearfoot pronation
- MS –L>R excessive rearfoot pronation, excessive tibial internal rotation

**Use Chart #4a To Answer The Following Questions**

- What condition(s) do you think she has?
- What deformity do you think she may have that's not noted in NWB and is causing gait compensations?
- What's the progression of the condition?
- What's your treatment plan? Explain
- Do you do anything differently during your assessment for her?

PATIENT PROFILE CASE STUDY | **Adults & Elderly II**

**Exercise 4.4**



4b



**ASK YOUR MENTOR**

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

**Complete a Case Study Analysis**

A 95-year-old man, who lives in a long term care facility, is brought to your office by his daughter complaining of R heel pain. He doesn't walk much but when he does, he uses a walker. He can't tell you much else about the pain.

**Patient Information & History**

- No medical conditions! Wow!
- No previous surgeries or injuries, recent X-ray results are negative
- He is wearing an old pair of New Balance walking shoes that have worn across the forefoot and toes of the sole
- NWB\*: Bil limited overall ROM, Bil hallux limitus, Bil callusing plantar IP jt of hallux, clawing of digits 2-5 and hallux is starting to hammer
- WB: Rigid Pes Planus, RF normal, knees are flexed, hips are flexed, tibia are normal, trunk leans forward

Gait:

- HS – Central and very low
- LR – Moderate rearfoot pronation, knees and hips excessively flexed
- MS – Moderate rearfoot pronation, lowering of medial arch, knees and hips excessively flexed
- HL – Limited, knees and hips excessively flexed
- TO – Limited, knees and hips excessively flexed
- SW – Shuffle gait with very little ground clearance

**Use Chart #4b To Answer The Following Questions**

- What condition(s) do you think he has?
- What's the progression of the condition?
- What's your treatment plan? Explain
- Do you do anything differently during your assessment for him?

## PATIENT PROFILE CASE STUDY | **Athletes**



### ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

### Exercise 4.5

## Complete a Case Study Analysis

A 16-year-old girl, who is a competitive international swimmer, comes to your office and complains of L arch pain. It's been happening on and off for the last few years, but the pain has gotten worse over the last 6 months. She is also noticing pain in her medial lower leg.

### Patient Information & History

- No medical conditions
- No previous surgeries or injuries
- She works out a lot, she's in the pool and gym daily and runs 5 days a week, about 5km each run. The pain gets worse with running especially
- She wears Toms (casual slip on canvas shoes), Uggs in the winter, nothing in the house and running shoes when working out
- NWB\*: L>R hypermobile ROM through RF, MF, STJ and 1st ray – no noticeable deformities or callusing, L>R 1st metatarsal medial cuneiform exostosis, L>R hallux valgus (mild), L>R FHL, Bil limitation in ankle DF due to tight gastroc, L FF supinatus
- WB: Bil RF valgus, L>R flexible pes planus, Bil Genu recurvatum, bil squinting patellae
- Testing: Hip adductors are stronger than abductors and external rotators (she swims the butterfly and based on the kick she does with this particular swim, this muscle imbalance makes sense)
- MS –L>R excessive pronation, L>R excessive tibial & femoral internal rotation
- HL – L>R prolonged rearfoot pronation and early heel lift with continued excessive tibial & femoral internal rotation and genu recurvatum
- TO – L>R medial toe off but she's adducted through entire gait L>R and major genu recurvatum
- SW – L> R adducted and pronated

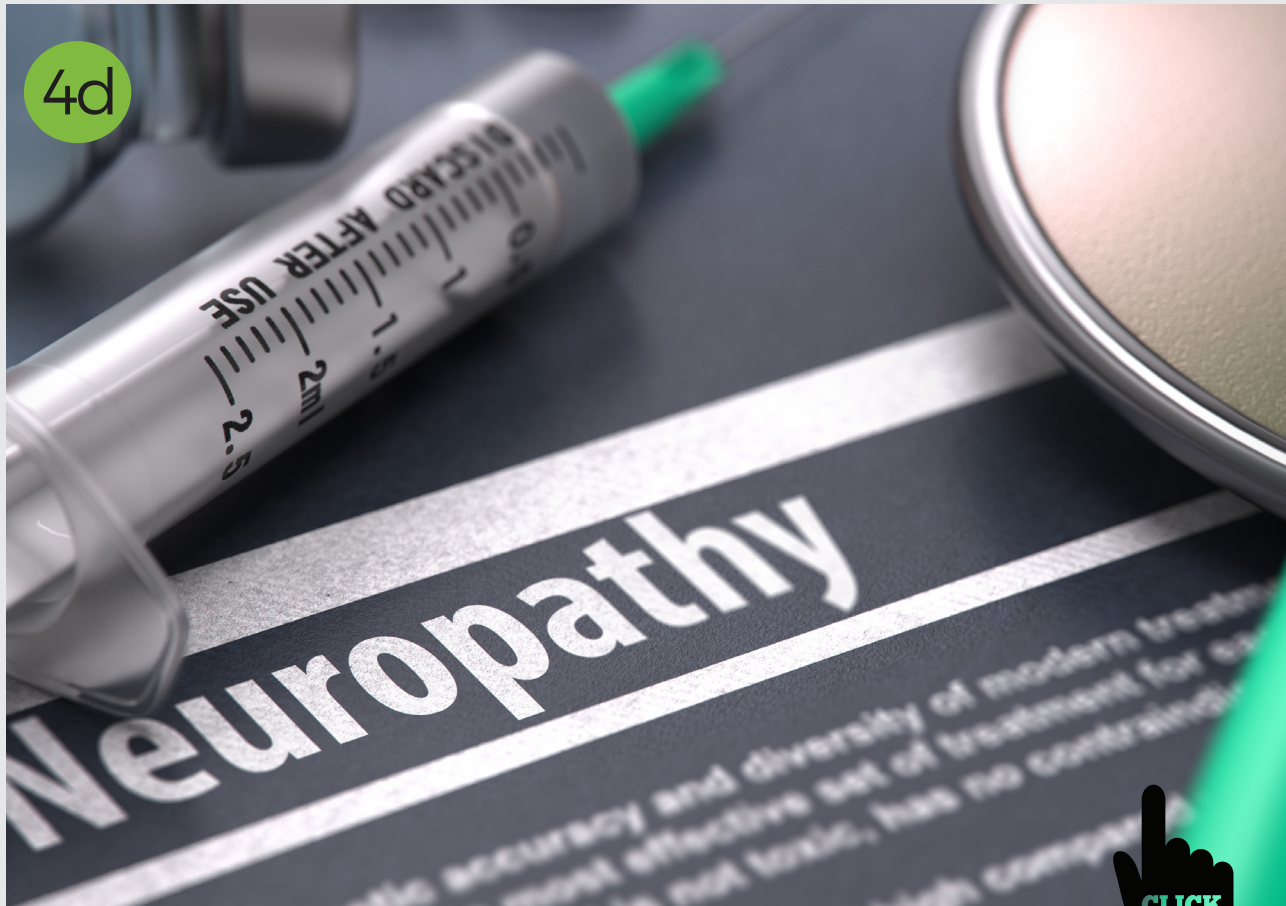
### Use Chart #4c To Answer The Following Questions

- What possible condition(s) do you think she is presenting with?
- What is causing her to TO the way she is? How is medial toe off and adduction happening together?
- What's your treatment plan? Explain
- What do you do differently during your assessment because she's an athlete?

Gait:

- HS – L>R medial and low
- LR – L>R excessive pronation

## PATIENT PROFILE CASE STUDY | Neurological



4d

CLICK  
HERE

### ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

### Exercise 4.6

## Complete a Case Study Analysis

A 40-year-old woman, who is working full time as an office worker, comes to your office due to a recurring foot ulcer. It's been happening on and off for a number of years (more than 10). Her ulcer is on her L 5th MTPJ.

She has neuropathy but is not diabetic. She has no feeling about 1/2 way down her leg and foot. She sits at work for the most part and doesn't do any activities, aside from daily living activities, due to the ulcer.

### Patient Information & History

- She was born without a L hip joint and has undergone over 20 surgeries since she was a baby on her back and pelvis, she has already had an amputation of her 3rd metatarsal due to osteomyelitis a few years ago.
  - She has a LLD – L is shorter by 3", no muscle control in her L lower leg or foot at all, and that foot is 3 sizes smaller than the R.
  - She is wearing kids shoe because of the size of her feet (sz 3L sz 6R) but they aren't wide enough and she's wondering if that's part of the problem.
  - NWB\*: L foot is very floppy, it sits in a plantarflexed and inverted position naturally and because she has no muscle control when the foot reaches initial contact it lands on the 5th MTPJ, pes equinus, limited RF eversion
  - NWB: R normal ROM overall, normal foot structure, no hallux limitations, no callusing or deformities
  - WB: she is using crutches currently to keep weight off L foot, but without them her L shoulder and hip and knee are all lower than the R, her R knee is majorly flexed, her L heel doesn't come in contact with the ground nor does her hallux, R RF normal, knee is normal aside from the flexing for compensation of the LLD
- Gat
  - HS – L FF strike laterally on the 5th MTPJ, R central
  - LR – L supinated, R normal pronation
  - MS – L supinated, R excessive pronation
  - HL – L heel never contacts the ground, R is delayed
  - TO – L low gear, R normal
  - SW – L plantarflexed ankle, R circumducts and hip hikes to clear ground

### Use Chart #4d To Answer The Following Questions

- What are your concerns of progression in her case?
- What is your treatment plan for her?
- Was this patient treated holistically? How would you do her assessment differently?

PATIENT PROFILE CASE STUDY | Disability

Exercise 4.5



Complete a Case Study Analysis

A 50-year-old woman, who is on disability, comes into your office and complains of L knee pain, hip pain and low back pain (all on the L side). It's been happening on and off for a number of years, but the pain is getting worse.

She describes the pain as aching.

She doesn't walk much but when she does, falling is a great worry.

Patient Information & History

- She suffered a stroke at the age of 20 and it pretty well paralyzed her L side. She has some control but no muscle strength, but she has full speech and communication
- No previous surgeries but she fell recently which spurred her to come see you
- She is currently wearing a custom AFO and running shoes
- NWB\*: L normal ROM throughout but feels very low tone, very limited ankle DF (verging on pes equinus), FHL
- NWB: R normal ROM throughout also mild limited ankle DF and normal hallux ROM, no other deformities or callusing noted
- WB: Bil RF normal, L Genu recurvatum, otherwise straight, normal arch structure, pelvis appears level
- SW – R short with low ground clearance, L knee is still hyperextended and pelvis still rotated, then weight shifts to the R, trunk leans to the R, L hip hikes, L pelvis is drawn anteriorly in order to bring L leg through swing, foot is plantarflexed, low ground clearance or occasionally drag

Use Chart #4e To Answer The Following Questions

- What may be causing her pain?
- Why is she getting genu recurvatum on her L so badly? (when she wears the AFO the Genu recurvatum is worse)
- What is your concern of progression for her?
- What is your treatment plan? Explain.
- Did you do anything differently in her assessment because of her disability?

- Gait:
- HS – L central but very low, R central
  - LR – Bil mild excessive rearfoot pronation, L Genu recurvatum starts here and continues until swing, L drop foot
  - MS – Bil mild excessive pronation, L Genu recurvatum continues and pelvis starts to rotate
  - HL – delayed L>R
  - TO – Limited L>R, L knee hyperextended, pelvis rotated posteriorly on L

ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example



PATIENT PROFILE CASE STUDY | **Diabetes**



4f

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HERE

ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

Exercise 4.6

Complete a Case Study Analysis

A 65-year-old retired man is sent into your office for ulcer management. His foot care nurse is concerned about callusing leading to recurring ulcers on his R hallux at the IP joint and on his L midfoot.

He has diabetic neuropathy and has suffered a Charcot foot on his L 2 years ago. The ulcer on his L healed less than a year ago, and the ulcer on his R healed only 2 weeks ago.

Patient Information & History

- No previous surgeries and his Charcot foot wasn't caught until it was too late and the ulcer was found
- He has a good pair of New Balance walking shoes that are only 3 months old, but his L shoe has worn into a rocker bottom and the sole is starting to detach due to all the pressure
- NWB\*: L limited ROM completely (including plantarflexion), lesser digits are clawed, hallux Rigidus, his toenails are all black and he doesn't report injuring them, skin is callused along midfoot drop medially and plantar base of 5th
- NWB: R overall normal ROM, slightly limited in 1st ray and ankle DF, hallux rigidus
- WB: Thoracic scoliosis, R hip higher than L, L rigid pes planus, R flexible pes planus
- TO – L toe off is abducted, none of his toes even contact the ground, R abductory twist
- SW – his gait is ataxic, swing occurs very quickly

Use Chart #4f To Answer The Following Questions

- What is causing his ulcers?
- What is your treatment plan to prevent ulcers and amputation?
- Would you do anything differently if you were assessing this patient?
- If you had a patient who has diabetes but has full feeling and no deformities and is complaining of heel pain what would you do:
  - How would his assessment look in comparison to our friend with diabetic neuropathy and a Charcot foot?
  - How would your assessments look if we compared a low-risk diabetic with plantar fasciitis to a non-diabetic with plantar fasciitis?

Gait:

- HS – R central, low, L midfoot strike
- LR – Bil excessive pronation, L very unstable during inle leg stand (see objective 5.1 for description)
- MS – L rocking on midfoot and body shifts to the R, then R supinates to compensate for the instability on L to bring the body weight back to centre
- HL – L heel lift limited – foot rolls forward on midfoot and heel lifts, R limited due to instability on L during SLS

## PATIENT PROFILE CASE STUDY | Arthritis



### ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Bring a print out of the Chart #4 (a,b,c,d,e,f,g) the one you found to be most difficult, to your mentor.
- Ask your mentor to take a few minutes to look over the chart with you.
- Ask if they can review the case study that matches the category and see if they would answer any of the questions differently than you.
- Ask if they can discuss a patient case that relates to that section as a second example

### Exercise 4.6

## Complete a Case Study Analysis

An 85-year-old woman, who is retired, comes into your office and complains of plantar foot pain. It's been happening for a number of years (flare ups can occur and make things more severe) but is to the point she can barely walk to her mailbox.

Her pain is a constant ache, but she also gets fluid filled pockets under her skin at her metatarsal heads. The fluid leaks and will cause a small ulcer.

She sits a lot through the day but lives on her own and wants to continue to do her normal daily chores. She feels very unstable walking and is worried about falling.

### Patient Information & History

- Arthritis in her hands and feet that is deforming her joints
- No previous surgeries but feels like she could go over on her ankles (inversion) any time
- She is wearing custom made shoes 100% of the time
- NWB\*: Limited RF eversion, excessive inversion, very limited rf DF, ff equinus rigid, limited MF ROM, very dropped transverse arch rigid, Pes cavus, claw toes 2-5 and hallux is hammered, small corns on hallux and 2nd digits from previous rubbing
- WB: RF varus, genu valgum L>R, rigid Pes Cavus

#### Gait:

- HS – flatfoot strike, excessive lateral, and occasional FF strike
- LR – Bil supination
- MS – Bil lack of rearfoot pronation
- HL – Bil early, knees in valgum and flexed
- TO – Bil limited
- SW – short and unsteady

### Use Chart #4g To Answer The Following Questions

- What type of arthritis do you think she has? Why?
- What is your treatment plan to prevent ulcers and amputation?
- What is your treatment plan for her?
- Was this patient treated holistically? Did you do anything differently in your assessment because of her arthritis?

OBJECTIVE FIVE

# Functional Tests

When you complete this objective you will be able to...

Characterize the purpose and relevance of various functional tests that can be used for patient assessment.

†NOTE:

For acronyms used in this workbook please see the glossary at the end of this workbook.

**LEARNING MATERIAL**

Functional tests are an important part of our pedorthic assessment, as they can help you determine the condition you'll be treating. For example, there are many conditions that can cause heel pain, and along with the symptoms and your assessment findings, functional tests are helpful in ruling in or ruling out differential diagnoses. Without these tests we wouldn't always be able to have a full understanding of the condition we're dealing with and it may impact our treatment plan.

This chart will give you some examples of functional tests grouped by body section and differential diagnoses. You can use the chart during your assessment as a guide for which test to perform and when it's ideal to use.

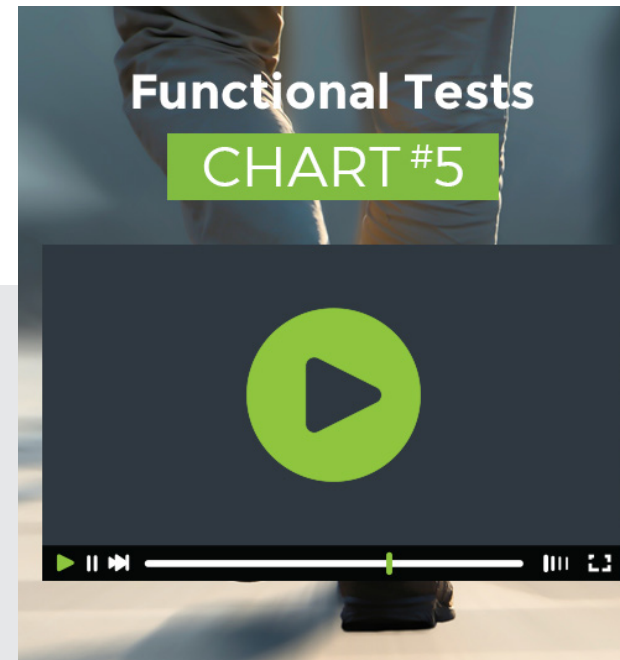
It also compares differential diagnoses to help you identify the involved tissues or possible condition throughout your assessment so you can incorporate the best options in your treatment plan!

There is a link beside each test to a "how to" video as well!

**Exercise 5.1**

**Functional Tests: Differentiating Diagnoses**

Open up the chart on the next page by double clicking on the icon. Take a look at each of the columns and the information presented there. Print out the chart as a separate document as we will be using this chart to solve a few case studies in the upcoming practice exercises. This chart will help you to correlate important concepts and when considering patient conditions and potential pathomechanical issues.



**Exercise 5.2**

Now that you've gone through your hands-on assessment and gait analysis and are trying to form your treatment plan, what happens if you're not sure what the condition is? Let's look at the last set of case studies.

**Questions**

1. From the case studies in objective 4:
  - a. Children – which test(s) would you perform to either rule in or rule out the condition?
  - b. Would you do the test any differently with a child? What if the child has autism and is non-verbal?
  - c. Adults & Elderly 1 – which test(s) would you perform to either rule in or rule out the condition?
  - d. If you needed to do the same tests on both cases (the 28 YO and 95 YO) how would they differ or would they differ?
  - e. Athlete - which test(s) would you perform to either rule in or rule out the condition?
  - f. Would you do the test any differently with an athlete?
  - g. Neurological – What would you do in this case? Is testing needed? How would you preform tests on these individuals?
  - h. Disability – What would you do in this case? Is testing needed? How would you preform tests on these individuals?
  - i. Diabetic – What would you do in this case? What if they are low risk diabetic?
  - j. Arthritis – What would you do in this case? Does the type of arthritis matter when it comes to testing?

## ASK YOUR MENTOR

Make an appointment with your mentor and be clear that it will take no more than 15-20 minutes for this exercise.

- Watch the linked YouTube videos with your mentor and ask their opinion and how they use each test, if it differs depending on the case, when they wouldn't do testing?

## ANSWER KEY

## Exercise 1.1 Answers

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### 1a. What are other possible ROM findings?

- i. Increased abduction, limited DF, excessive MF inversion, limited MF eversion, hypermobile 1st ray, hallux limitation

### b. What does their potential gait look like in each phase?

- i. HS – low and medial heel strike
- ii. LR – excessive pronation
- iii. MS – excessive pronation
- iv. HL – early heel lift and prolonged pronation
- v. TO – medial toe off
- vi. SW – abducted

### c. What may their primary, secondary and tertiary complaints be?

- i. Primary – plantar fasciitis
- ii. Secondary – medial arch, pain along the post tib tendon, inferior lateral malleolus
- iii. Tertiary – knee pain (poss lateral OA)

### d. What is your treatment plan for this patient?

- i. Orthotics – rigid material to control pronation, high heel cup to control rearfoot valgus, medial forefoot post to accommodate ff varus, heel raise to manage early heel lift and limited DF
- ii. Footwear – wide, deep to accommodate orthotic, stable heel counter and midsole with rigid forefoot rocker
- iii. Other Recommendations – stretching posterior compartment, strengthening tibialis posterior, PT if needed, footwear in the house, control as much as possible to prevent progression

### 2.a. What possible WB findings may you see that could lead to a condition like this?

Genu varum, tibial varum

### b. What gait compensations could be occurring in this patient?

Excessive varus moment at midstance, could have pronation or supination depending on foot type

### c. What is your treatment plan for this patient?

Orthotics – address improper mechanics, add lateral rearfoot post to reduce varus moment

Footwear – neutral cushioning footwear – goal is to reduce varus moment and pressure on medial compartment

Other Recommendations – offloading knee brace, PT

### 3. A patient presents with an abductory twist during heel lift phase of their gait analysis. Write a case study that shows the potential assessment outcomes (ie NWB, WB and gait assessment). What would you do to address this?

#### a. What possible NWB\* findings may you find?

NWB: normal RF and MF ROM, limited DF due to gastroc, FHL (or other hallux limitation), callusing under 2nd metatarsal head

#### b. What may you expect to see during the WB\* assessment?

WB: Flexible pes planus, mild genu valgum, tibial internal rotation

#### c. What gait compensations may you see during the gait assessment?

Gait: HS – central and low, LR – excessive pronation, MS – excessive pronation and excessive tibial internal rotation, HL – early, abductory twist, TO – appears off 2nd metatarsal head, limited, SW – abducted

#### d. What would you do to address this in your treatment plan?

Treatment: Orthotics – control pronation, heel lift, manage FHL (ie. If your goal is a normal toe off do you need to do a first ray cut out or kinetic wedge to achieve more hallux ROM)

Footwear – stable to ensure pronation and tibial internal rotation is controlled, rigid FF rocker to help with hallux limitation

Other Recommendations – Stretching posterior compartment

4. A patient presents with an abductory twist during heel lift phase of their gait analysis. Write a case study that shows the potential assessment outcomes (ie NWB, WB and gait assessment). What would you do to address this?

## 1.2 Answers

---

### a. Is there anything that was possibly missed in the NWB part of this assessment?

R Forefoot varus

### b. What condition(s) do you think she is presenting with?

PTTD and plantar fasciitis

### c. Is the above treatment correct? Yes or no and explain why or what you would do differently.

No, she needs to be controlled more so new stable footwear (stiff heel counter, stiff midsole and rigid FF rocker) that will accommodate a full length orthotic is very important and the post needs to be a FF medial post not RF if she has a FF varus. I agree with the plastic shell and depending on the heel height of the shoe I'd also add a heel lift. She also needs to stretch her posterior compartment, strengthen her tibialis posterior and ice or heat her lateral ankle for the swelling.

### d. Was this patient treated holistically? What would you do the same or different to achieve this?

The patient was treated for plantar fasciitis, not the progressive PTTD. I would follow the above treatment plan and add the double and single heel raise tests into my assessment to ensure I've captured everything.

## ANSWER KEY

## Exercise 2.2 Answers

### 1. Name each of the abnormal mechanics you see in each phase of gait and don't forget to comment on the R and L side.

- Heel Strike – Bil Excessive Lateral, L low (almost flat foot)
- Loading Response – Bil Lack of Pronation
- Midstance – Bil Lack of Pronation, L knee (tibia and femur) appear to excessively externally rotate
- Heel Lift – L slightly delayed (due to posterior pelvic rotation on L and anterior rotation on R), R normal with an abductory twist
- Toe Off – Normal (because he has L PF 1st ray and R ff valgus)
- Swing – L>R Abducted

### 2. What is the best treatment option for the patient in this case? Explain.

Orthotics – Semi-rigid orthotics (to help increase shock absorption), 1st ray cut outs and FF lateral posts, possible L RF lateral post as well if needed to control supination, cushion, metatarsal pads

Footwear – Neutral shoes, wide and deep to accommodate pes cavus foot and claw toes, cushioned

Other Recommendations – stretching for posterior compartment

### 3. Based only on what you see, what condition do you think patient in this video may have? Deformities?

#### Peroneal Tendonitis

PF 1st ray, FF valgus, RF varus, Pes Equinus

### 2. What compensations would you expect to see with the short limb in a LLD?

Excessive lateral heel strike, possible flatfoot or forefoot strike, supination (or lack of pronation), early heel lift, low gear toe off, vaulting, external rotation of knee and hip

### 3. What abnormal motions can be caused by a FF varus?

Excessive and prolonged pronation (throughout entire gait), medial heel strike, medial toe off, early heel lift, abductory twist, abduction

### 4. Why may a delayed heel lift occur? What do you do about it in your treatment plan?

- Pain avoidance at the FF – address pain
- Genurecurvatum – heel lift
- Pes Calcaneus – FF post
- Weak Plantarflexors – therapy for strengthening, rockered footwear
- Shuffle gait – address cause for shuffle and create stability

### 5. What would the ideal treatment be for someone with a hallux Rigidus? Why?

Rigid FF rocker via: Rigid hallux extension to the orthotic, rigid plate (in the shoe or attached to the orthotic), rigid FF rocker in shoe or add rocker soles as a footwear modification

## 3.1 Answers

### 1. With what compensations would you choose to add heel lifts? Why?

- Medial/Central Heel Strike – if pronation is a compensation for limited DF
- Excessive lateral Heel Strike – if due to a LLD
- Low/Flatfoot Strike – if due to a LLD or limited DF
- Forefoot Strike – accommodate as necessary with a heel lift due to pes/ff equinus, LLD, drop foot, knee injury (lack of knee extension)
- Excessive Pronation – if it's a compensation for limited DF or PTTD
- Foot Slap or drop – if not using AFO, possibly accommodate with heel lift
- Early heel lift – due to Pes/FF equinus, lack of knee or hip extension, limited DF, PTTD (due to change in the position of MF bones)
- Delayed Heel Lift – due to Genurecurvatum, pes equinus
- Prolonged pronation – due to pes equinus or possibly PTTD
- Abduction (during swing) – if cause is due to limited DF or pes equinus
- Swing compensations due to LLD or others noted above

## 3.2 Answers

### a. Match the abnormal motion occurring in the above case study to the phase of gait it occurs in:

- Heel Strike – Excessive lateral and flatfoot
- Loading Response – Foot slap, R>L Supination
- Midstance – R>L Supination, excessive ext rotation
- Heel Lift – Delayed heel lift, excessive ext rotation
- Toe Off – Low Gear, excessive ext rotation
- Swing – High Steppage, excessive ext rotation

### b. What are the potential causes of each gait compensation (abnormal motion)?

- Excessive lateral, flatfoot strike – RF Varus, Pes Equinus and limited RF and MF dorsiflexion
- Foot slap, R>L Supination – Weak ankle dorsiflexors (CMT), PF 1st ray, FF valgus, RF varus, CMT, Rigid Pes Cavus
- Excessive external rotation – genuvarum, compensation for high steppage gait
- Delayed Heel lift – pes equinus, forward trunk lean (hips flexed), weak plantarflexors (CMT)
- Low Gear – Peroneus longus weakness (CMT), Rigid PF 1st ray/FF valgus
- High Steppage – foot drop (CMT)

## ANSWER KEY

### Exercise 3.2 Answers

**c. Which compensation(s) do you believe is(are) causing his hip and knee pain?**

High Steppage gait & excessive external rotation & forward trunk lean – compensations for foot drop and weak lower leg muscles and instability caused but his CMT

**d. What is the best treatment plan would you suggest for this patient?**

Orthotics – Accommodate FF deformities with lateral posts and 1st ray cut out, control supination with lateral RF posts, cushioned materials for shock absorbency, met bar for dropped transverse arch

Footwear – extra wide and deep, light weight to reduce chance for falls, 6” boot is best, helps add some stability. Possible modifications to footwear with split sole or lateral flare or buttress.

Other Recommendations – AFO, footwear 100% of time to reduce risk of falls

### 4.2 Answers

Use the chart in activity 4.1.a) to answer the following questions:

**a. What condition do you think he has?**

Sever’s Disease

**b. What’s the progression of this condition and what is your recommendation to his parents in regards to hockey?**

No progression, it will go away once the growth plate closes. Base on pain, if he can play without pain OK, if not sit out, but because there is no progression, playing will not cause any long term damage

**c. What’s your treatment plan? Explain**

Orthotics - Heel lifts in all shoes, possibly even skates, support MLA & RF as needed (OTC or custom)

Footwear – Stable running shoes with more firm support

Other Recommendations - Calf stretching (lots and lots!)

**d. What do you do differently during your assessment because he’s a child?**

Talk to him and not just his parents, get him to run or hold something while walking to distract him so you can get a “real” version of him walking, explain the process to him (including casting if needed and treatment options) to make him excited to follow your plan! Make stretching fun!

Use the chart in activity 4.1.b) to answer the following questions: 1

**a. What condition(s) do you think she has?**

PTTD

**b. What deformity do you think she may have that’s not noted in NWB and is causing gait compensations?**

L Forefoot Varus

**c. What’s the progression of the condition?**

4 stages, OA, rigid pes planus

**d. What’s your treatment plan? Explain**

Orthotics – Rigid controlling orthotics to prevent progression, UCBL heel cup to control L rf valgus, L medial FF post for the varus

Footwear – stable, neutral (so the R foot doesn’t get over corrected), rigid ff rocker, deep enough to accommodate the ff post

Other Recommendations – Strengthening exercise for the tibialis posterior, footwear and support worn as much as possible to prevent progression, possible bracing for L as needed

**e. Do you do anything differently during your assessment for her?**

Thorough exam including functional testing for tibialis posterior function and strength, we do not want to assume her pain is plantar fasciitis based on her age and symptoms, so these tests will help point to the correct condition so we can treat appropriately and ideally prevent progression

Use the chart in activity 4.1.b) to answer the following questions: 2

**a. What condition(s) do you think he has?**

Based on the little we know about his heel pain it could be a few things, but based on his age could be heel fat pad syndrome or possibly plantar fasciitis

**b. What’s the progression of the condition?**

Heel fat pad syndrome doesn’t really progress but the cause is lack of fat pad (usually due to aging) so it will continue to thin over time.

**c. What’s your treatment plan? Explain**

Because he’s rigid pes planus and has a shuffle gait, I’d recommend a soft accommodative orthotic, made from soft EVA’s, natural cork or plastazotes, lined with poron and covered with pink plastazote, I’d also add a small soft heel lift to try to redistribute pressure back to his heel and offload the pressure at the forefoot as seen by the shoe wear

Footwear – I’d recommend the same type of shoe, stable with rigid forefoot rocker

Other Recommendations – due to his age, I’d recommend daily assisted walking and ideally ensure his walker doesn’t get too far in front of him which will cause his trunk to lean forward even more

## ANSWER KEY

## Exercise 4.2 Answers

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**d. Do you do anything differently during your assessment because of his age?**

Because his skin is so thin and sensitive, and he has very little fatty tissue, I was very careful with my hand and finger placement and the pressure I used during my hands on assessment. I also made sure he walked with his walker and was assisted by a therapist. I didn't have him walk far as he's not accustomed to walking barefoot

**Use the chart in activity 4.1.b) & 4.1.c) to answer the following questions:**

**a. What possible condition(s) do you think she is presenting with?**

PTTD (the medial leg pain could be MTSS but still may be the tibialis posterior)

**b. What is causing her to TO the way she is? How is medial toe off and adduction happening together?**

Her femur is internally rotated as is her tibia, caused by potential femoral anteversion or muscle imbalances between her thigh adductors and abductors – this causes her to be adducted throughout gait and her prolonged pronation causes the medial toe off. The hypermobility in her feet and knees (Genu recurvatum) is also allowing this to happen

**c. What's your treatment plan? Explain**

Orthotics – control pronation with rigid material to prevent any progression, possible rearfoot varus posting and heel lift but because of the hypermobility and her athletic ability I'd wait before adding to see if she can adapt

Footwear – Sport specific, good stable running shoes and supportive sandals to wear in the house

Other Recommendations – stretching and strengthening to work on muscle imbalances and gastroc tightness, however I would recommend she speak with her coaches and trainers first to ensure anything she does won't negatively affect her sport

**d. What do you do differently during your assessment because she's an athlete?**

She can do more testing that won't put her under stress, so I'd perform more muscle tests to see if there are imbalances causing some of her problems and try to differentiate between PTTD or MTSS causing the leg pain, I'd also rule out compartment syndrome based on her level of activity

**Use the chart in activity 4.1.d) to answer the following questions:**

**a. What are your concerns of progression in her case?**

Amputation, infection

**b. What is your treatment plan for her?**

Orthotic – offload the ulcer. She presents a unique situation for offloading. Due to her LLD and foot size and weakness + neuropathy of that leg, normal offloading with a shoe or boot doesn't work. A TCC (total contact cast) would be ideal, however the patient is hesitant. I would treat this like a diabetic and make a soft full length accommodative orthotic with a heel lift on the L, offload the ulcer, lateral rf post, soft pink plastizote topcover

Footwear – light stable shoes with enough width and depth to fit her different size feet, lift added with light material and a lateral flare to help reduce the supination and lateral forefoot strike

Other Recommendations – regular wound care, physiotherapy to strengthen hip muscles, possibly a walking aid like crutch or cane or walker

**c. Was this patient treated holistically? How would you do her assessment differently?**

She needs to be treated like a person living with an ulcer not someone at risk of amputation, even though it's a concern.

Our treatment needs to work in her lifestyle, her job, her home life with her kids. As we create this treatment plan, she needs to be a part of the creating so she's more likely to follow it. Together we will manage her ulcer that she's been living with for many years

**Use the chart in activity 4.1.e) to answer the following questions:**

**a. What may be causing her pain?**

Genu recurvatum and compensation through swing – muscles are over working to make this happen + muscle weaknesses from her stroke

**b. Why is she getting genu recurvatum on her L so badly? (when she wears the AFO the Genu recurvatum is worse)**

It's a compensation for her drop foot and pes equinus (ankle and foot can't compensate so it moves up the limb to the next joint). When wearing the custom rigid AFO it blocks any movement in her rearfoot, so in order to progress forward some compensation needs to occur (either high steppage, vaulting or circumduction), but due to her paralysis and weakness these movements won't happen so we see genu recurvatum, pelvic rotation and pelvic thrust at heel lift to swing as compensations

**c. What is your concern of progression for her?**

Continued muscle weakness, risk of falls, potential OA in hip and knee due to excessive movements

**d. What is your treatment plan? Explain.**

Orthotic – we can't do much with her gait from an orthotic standpoint so our goal is to offload any pressure areas in the foot if she has decreased sensation. I'd recommend a heel raise to try to reduce her genu recurvatum

Footwear – light weight and deep enough to accommodate her AFO and orthotic

Other Recommendations – AFO with open heel (ie. Allard Toe-Off), gait retraining to get quads and hip flexors firing

**e. Did you do anything differently in her assessment because of her disability?**

The limitations in her assessment may be any required testing or gait analysis barefoot. She is very unstable so I kept her barefoot walking to a minimum. Her stroke affected her L arm and hand as well, so we need to ensure she can get her shoe on and off and chose a shoe that would best fit this

## ANSWER KEY

## Exercise 4.2 Answers

Use the chart in activity 4.1.f) to answer the following questions:

**a. What is causing his ulcers?**

Pressure from his Charcot foot on the L and the R hallux ulcer is being caused by his ataxic gait and instability from the L Charcot foot

**b. What is your treatment plan to prevent ulcers and amputation?**

Offload!

Orthotics – L needs to accommodate the midfoot rocker bottom with a heel lift to take pressure off, R needs to manage the pronation and offload the callusing at the ulcer. The R ulcer/callus will improve once the L foot is stabilized and the ataxic gait is reduced, cover with pink plastazote to reduce friction and shearing forces

Footwear - needs to be extra width and depth to accommodate his L Charcot foot and the heel lift, rigid forefoot rocker with stable heel counter and midsole

Other Recommendations – wound/foot care to prevent callus build up, regular checkups to check and manage pressures on orthotic

**c. Would you do anything differently if you were assessing this patient?**

He is very unstable barefoot, be cautious in having them walk barefoot and keep it to a minimum, ensuring the walking surface is very clean. When trying footwear, go by your measurements and fitting, not necessarily by how the patient feels. He may want the shoe tighter than it should be due to his lack of sensation. I'd also keep any WB testing to a minimum

**d. If you had a patient who has diabetes but has full feeling and no deformities and is complaining of heel pain what would you do:**

**a. Treatment plan? Explain.**

Orthotics – would be treated for plantar fasciitis vs diabetes – semi-rigid orthotic (depending on ROM in foot), additions based on assessment, cushioning based on assessment. Annual follow up to ensure we catch anything changing in regards to their diabetes

Footwear – based on assessment

**b. How would his assessment look in comparison to our friend with diabetic neuropathy and a Charcot foot?**

His assessment may be less delicate, with more functional testing and a full gait assessment. Since he has no loss of protective sensation he can tell us if something causes pain where as our friend with the Charcot foot can't

**c. How would your assessments look if we compared a low risk diabetic with plantar fasciitis to a non-diabetic with plantar fasciitis?**

I think the assessments would be similar once we've ruled out any loss of protective sensation. I may always be a little more cautious with the diabetic patient vs the other and treatment may differ slightly with respect to materials (ie I may avoid more rigid materials for the diabetic patient, but it would depend on their ROM and assessment findings as well)

Use the chart in activity 4.1.g) to answer the following questions:

**a. What type of arthritis do you think she has? Why?**

Rheumatoid Arthritis, deforming joints, flare ups, fluid filled pockets

**b. What is your treatment plan for her?**

Orthotics – Offload her heel and forefoot by aggressively supporting the arch (but using semi-rigid material so it's tolerable), heel lift for pes equinus, poron cushion lining and plastazote cover to dissipate friction and shearing forces, excavate for ulcer to offload it further

Footwear – extra depth, extra width footwear or custom made shoes to accommodate deformed joints in forefoot

Other Recommendations – regular footcare or follow ups to ensure ulcer heals

**c. Was this patient treated holistically? Did you do anything differently in your assessment because of her arthritis?**

RA is a disease that flares, so I would be cautious to manipulate her joints too much. My hands on assessment would be as minimal as possible to get the information I need. Walking barefoot is very painful and uncomfortable so my gait assessment would be minimal as well. I wouldn't perform any tests in her assessment. It's important to treat her as a patient with this disease and not treat her as the disease itself

## 5.2 Answers

**1. From the case studies in objective 4:**

**a. Children – which test(s) would you perform to either rule in or rule out the condition?**

- Heel squeeze test to rule out Calcaneal Stress Fracture
- Windlass test to rule out Plantar Fasciitis
- There isn't a test to rule in Sever's Disease

**b. Would you do the test any differently with a child? What if the child has autism and is non-verbal?**

Kids can be more fidgety, more ticklish, have a more difficult time understanding what you're doing or what they need to do.

I would give the child something to do while I perform the above tests. The difference with a child who is autistic is they may not allow you to touch them or do the tests. You may need to find alternate ways to get the information you're looking for. It may also be difficult to get the needed feedback for the above tests from a non-verbal child

**c. Adults & Elderly 1 – which test(s) would you perform to either rule in or rule out the condition?**

- Double and single heel raise test to rule in PTTD
- Windlass Test to rule out plantar fasciitis



## ANSWER KEY

### Exercise 5.2 Answers

**d. If you needed to do the same tests on both cases (the 28 YO and 95 YO) how would they differ or would they differ?**

I wouldn't do the double and single heel raise test on the 95 YO, I would treat their testing very differently based on their ages and conditions. The only thing I may do on the 95 YO is the Plantar Fascia palpation to rule out plantar fasciitis

**e. Athlete - which test(s) would you perform to either rule in or rule out the condition?**

Double and single heel raise test to rule in PTTD

Palpation of medial tibia to rule in or out MTSS (not a functional test, however helpful to know if this causes pain or not)

Resisted Strength test of the Tibialis Posterior with palpation of the posteromedial lower 1/3 of the tibia to rule in or out tibialis posterior muscle involvement

Heel and Toe walking to rule out compartment syndrome

Windlass test to rule out Plantar Fasciitis

**f. Would you do the test any differently with an athlete?**

As you can see above I would do many more tests because she's an athlete than what I would do on a non-athlete. They can also get pushed a little harder when doing the tests, than I would a sedentary individual

**g. Neurological – What would you do in this case? Is testing needed? How would you preform tests on these individuals?**

I wouldn't do any functional WB testing with this patient due to her ulcer, however I may incorporate some muscle strength tests to see where her weakness is compared to her other foot. I would do so carefully as she can't tell me if anything is painful or if my grip is too tight

**h. Disability – What would you do in this case? Is testing needed? How would you preform tests on these individuals?**

In this case, she suffered the stroke 20 years ago so has been walking this way for a very long time. I wouldn't need to do any functional WB tests, but what I would try with her shoes, orthotics and AFO on is some gait retraining to see how quickly she may pick it up. In this case the goal is to get her hip and knee to flex so her job was to step forward while holding onto a wall for support

**i. Diabetic – What would you do in this case? What if they are low risk diabetic?**

I wouldn't do any functional WB tests on him being neuropathic, but I would do a monofilament test so I have a record of his loss of protective sensation. If the patient is a low risk diabetic with no loss of sensation I would perform functional tests based on their assessment and symptoms

**j. Arthritis – What would you do in this case? Does the type of arthritis matter when it comes to testing?**

I don't think there's any need to do functional tests for RA. Again I'd be concerned to flare her for no reason as it wouldn't change my treatment options. If she had OA, muscle tests may be an option to see if physiotherapy would be beneficial for them

### Glossary of Terms / Key Concepts:

PTTD – Posterior Tibial Tendon Dysfunction

AN – Accessory Navicular

FF – Forefoot

MF – Midfoot

RF – Rearfoot

STJ – Subtalar Joint

LLD – Leg Length Discrepancy

ITBS – Iliotibial Band Syndrome

OA - Osteoarthritis

SLS – Single Leg Stance

AFO – Ankle Foot Orthosis

DF – Dorsiflexion

PF – Plantarflexion (or plantarflexed)

MTPJ – Metatarsophalangeal Joint

IP Joint – Interphalangeal Joint

ROM – Range of Motion

FHL – Functional Hallux Limitus

BOS – Base of Support

Bil – Bilateral

WB – Weight bearing

NWB – Non-weight bearing

HS – Heel strike

LR – Loading response

MS – Midstance

HL – Heel lift

TO – Toe off

SW – Swing

PT – Physiotherapy

**Deformity** – a permanent structural deviation from normal (ie ff varus)

**Disorder** – an irregularity or abnormal function such as an illness (ie plantar fasciitis)

**Pain Scale** – 0 = no pain, 10 = worst pain they've ever felt

**Treatment Plan** – full Pedorthic treatment including insoles, footwear, stretching, shoe mods, other health care provider recommendations

**Ataxic Gait** – uncoordinated movements, can appear "drunk"

**Antalgic Gait** – pain avoidance gait

**Scissor Gait** – crossing of the legs or knees with slow, small steps, usually due to spastic muscles, commonly seen in cerebral palsy

**High Steppage Gait** – excessive knee and hip flexion to allow the foot to clear the ground, due to drop foot

**Hemiplegic Gait** – forward trunk flexion and instability due to foot drop with circumduction (due to weakness or paralysis of one whole side of the body)

**Spina Bifida** – Neural tube defects at birth, can cause muscle weakness in the legs and sometimes paralysis, scoliosis, and possible foot deformities

**Onychomycosis** – Fungal infection of the nail

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# Study Guide

## Workbook 2

Pathomechanics, Conditions  
& Diseases