Driving Ability with Lower Extremity Dysfunction
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Temple University School of Podiatric Medicine
Philadelphia, Pennsylvania
Dr. Meyr: disclosed no relevant financial relationships with any commercial interests.
Learning Objectives

1) Review the effects of lower extremity surgery on driving function.
2) Review the effects of diabetes and diabetic neuropathy on driving function.
3) Review US national and state driving regulations affected by podiatric surgery.
Doctor, when can I start driving again after surgery?
• Liebensteiner MC, et al, 2010. Driving reaction time before and after primary fusion of the lumbar spine. *(PubMed ID#: 20075774)*
  
  – Studied driving reaction time before and after lumbar arthrodesis with comparison to a control group and with correlation to VAS pain scores
  
  – Control Group: **0.49 second**
  
  – Experimental Group: **0.69 second; 0.73 second; 0.67 second**
  
  – **Moderate to high correlations** between back pain and reaction times
  
  – Concluded it is “probably” safe for patient to resume driving following hospital discharge, but driving function continued to improve over a **3-month period**

• MacDonald and Owen, 1988. The effect of total hip replacement on driving reactions. (PubMed ID#: 3346288)
  – Postoperative driving reactions were statistically slower following either right or left hip replacement for most patients for **8 weeks**
  – Some patients were slower **up to 8 months** following the procedure
Lower Extremity Surgery and Driving

  - No differences observed 2 weeks after total knee replacement
  - Return to baseline about 4-6 weeks after arthroscopic anterior cruciate ligament repair
Lower Extremity Surgery and Driving

  - Return to baseline brake response time after ~9 weeks postoperatively

  - Brake response times were significantly reduced until ~6 weeks after initiation of weight bearing

  - Delayed brake reaction times in all patients with chronic lower extremity musculoskeletal disease (either right or left sided) who did not improve following local anesthetic injection

Lower Extremity Surgery and Driving

  - Evaluated 28 people undergoing surgery for hallux valgus deformity
  - Preoperative times were slower than those of a control group
  - 21 of 28 were unable to complete assessment at 2 weeks secondary to pain
  - Return to baseline in ~6 weeks

- Myerson, et al, 2011. Driving brake reaction time following right ankle arthrodesis. (*Pubmed ID# 22097166*)
  - Slower than control group, but not abnormally slow in relation to safety thresholds

Doctor, when can I start driving again after surgery?
American Diabetes Association committee 2012. Diabetes and Driving. *(PubMed ID#: 22187475)*


Engkasan JP, et al, 2012. Ability to return to driving after major lower limb amputation. *(PubMed ID# 22124514)*


Diabetic Sensorimotor Neuropathy

- Sensory neuropathy
  - Lack of plantar pedal sensation
  - *Think that might affect the depression of automobile pedals?*

- Motor neuropathy
  - Weakness, muscle atrophy, slowing of movements, unstable gait, infrequency of falls
  - *Think that might affect transitioning between the gas/brake pedals?*

- Foot wounds, partial foot amputations, Charcot neuroarthropathy….

- Diabetic auditory and visual reaction times….
Sensory neuropathy
• Lack of plantar pedal sensation
  • Think that might affect the depression of automobile pedals?

Motor neuropathy
• Weakness, muscle atrophy, slowing of movements, unstable gait, infrequency of falls
  • Think that might affect transitioning between the gas/brake pedals?

• Foot wounds, partial foot amputations, Charcot neuroarthropathy

• Diabetic auditory and visual reaction times
The Temple Diabetic Driving Studies

- **Control Group**
  - 25 active drivers with neither diabetes mellitus nor peripheral neuropathy

- **Experimental Group**
  - 25 active drivers with diabetes mellitus and peripheral neuropathy

- **Outcome Measures**
  - Mean brake response time from 10 emergency braking trials after practice
  - Frequency of abnormally slow reactions (≥0.70 second)
The Temple Diabetic Driving Studies

### Part I

**Control Group**
- 25 active drivers with neither diabetes mellitus nor peripheral neuropathy

**Experimental Group**
- 25 active drivers with diabetes mellitus and peripheral neuropathy

### Outcome Measures
- Mean brake response time
- Frequency of abnormally slow reactions (≥0.70 second)

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<td>P &lt; 0.001</td>
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(independent student t-test)
**Limitations**

- **Clinically significant?**
  - Mean measurements faster and slower than established safety thresholds
  - Difference of 0.21 second equates to a stopping distance of \(~21\) feet traveling at 55 mph

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Limitations

• *Fair comparison?*

  – Not matched for age, gender, or co-morbidities….

  1. Comparison to control kind of gets thrown out the window following comparison to safety threshold

  2. These are artificial designations in real life when considering the Division of Motor Vehicles and car manufacturers

  3. I get it…..

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Part II

Control Group
- 25 active drivers with diabetes mellitus but no peripheral neuropathy

Experimental Group
- 25 active drivers with diabetes mellitus and peripheral neuropathy
  - No differences in age and HbA1c but still a gender difference

Outcome Measures
- Mean brake response time
- Frequency of abnormally slow reactions (≥0.70 second)
**Part II**

**Control Group**
- 25 active drivers with diabetes mellitus but no peripheral neuropathy

**Experimental Group**
- 25 active drivers with diabetes mellitus and peripheral neuropathy
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## Limitations

- *Still a fair amount of heterogeneity in the experimental group with a large potential for confounding variables...*

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Part III

Control Group
- 20 active neuropathic diabetic drivers without foot pathology

Experimental Group
- 20 active neuropathic diabetic drivers with foot pathology (ulceration, amputation, Charcot)
- No differences in age, HbA1c, nor gender

Outcome Measures
- Mean brake response time
- Frequency of abnormally slow reactions (≥0.70 second)
**Part III**

- **Control Group**
  - 20 active neuropathic diabetic drivers without foot pathology

- **Experimental Group**
  - 20 active neuropathic diabetic drivers with foot pathology (ulceration, amputation, Charcot)
  - No differences in age, HbA1c nor gender

**Outcome Measures**
- Mean brake response time
- Frequency of abnormally slow reactions \((\geq0.70 \text{ second})\)

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<td>Mean ± standard deviation brake response time (seconds)</td>
<td>0.79 ± 0.22</td>
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Doctor, when can I start driving again after surgery?
It is likely that the combination of diabetes mellitus and neuropathy +/- specific foot pathology has the potential to negatively affect driving outcomes.

Now does this mean that this population cohort is at a greater risk for automobile accidents?

It is likely that foot pathology/pain itself and acute surgical intervention have the potential to negatively affect driving outcomes as well.
Lower Extremity Immobilization and Driving

- **Control Group**
  - 25 healthy volunteers in a sneaker

- **Experimental Group 1**
  - The same 25 healthy volunteers in a surgical shoe

- **Experimental Group 2**
  - The same 25 volunteers in a controlled ankle motion walker

- **Outcome Measures**
  - Mean brake response time from 10 emergency braking trials after practice
  - Frequency of abnormally slow reactions ($\geq 0.70$ second)
  - Frequency of inaccurate brake responses (inadvertently hitting the accelerator/brake pedal simultaneously during an emergency braking situation)
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Inaccurate brake responses refer to hitting the accelerator/brake pedal simultaneously during an emergency braking situation.
Lower Extremity Immobilization and Driving

  - Observed significant changes between a shoe, an air-cast walker, and walking cast in healthy volunteers

  - Slower response times and increased “thinking times” for ankle and knee braces

  - Observed significant changes between a shoe, an air-cast walker, and walking cast in healthy volunteers, but that did not exceed safety thresholds
No specific laws/restrictions on driving with a cast on, wearing immobilization devices, or postoperatively following lower extremity surgery.

Applicants are not specifically asked if they have diabetes mellitus, and the Medical Examination Form generally asks physicians about the presence of diabetes mellitus, no specific diabetic complications.

IL Medical Examination Form: https://www.cyberdriveillinois.com/publications/pdf_publications/dsd_dc163.pdf

Physicians are not required to report drivers with medical conditions that might affect driving and are immune from liability with respect to reporting.
It is likely that the combination of diabetes mellitus and neuropathy +/- specific foot pathology has the potential to negatively affect driving outcomes.

It is likely that foot pathology/pain, acute surgical intervention, and commonly utilized lower extremity immobilization devices have the potential to negatively affect driving outcomes as well.

This is a potentially underappreciated aspect of foot and ankle surgery and probably an area we should spend more time discussing with our patients.
Please do not hesitate to contact Andy if there is anything at all that he can do for you:


- **TUSPM Podcast Network**: [https://soundcloud.com/user-79150427](https://soundcloud.com/user-79150427)


**Questions?**

AJMeyr@gmail.com