Comparing the Incidence Rate of Pressure Injury Development in the Acute Adult Patient admitted through the Trauma Center with an Unstable Spine Requiring Surgery with or without a Spinal Cord Injury

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Dr. David Chesire/ Trauma Psychologist/ Statistician, Sub-Investigator
LEARNING OBJECTIVES:

- After participation in this session, the learner should be able to:
  1. Describe the rate of Pressure Injury (PI) development in the acute Spinal Cord Injury (SCI) population as compared with the rate of PI development in the general population
  2. Identify factors that lead to increased risk for PI development in this high risk population
  3. Describe the effect of prolonged pressure/force in relation to the formation of PI in the SCI population
  4. Identify how reduction of pressure/force over the sacral/coccyx (bony) prominences can aid in reducing the occurrence of PI development in the acute SCI population
Conflict of Interest: Provisional Patent filed with U.S. Patent Office in May 2019

Employer: UF Health Shands Jacksonville
Jacksonville, Florida

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Gazafar Rahmathulla & David Chesire, Sub-Investigators
SPINAL TABLE CUSHION STUDY
Spinal Stabilization Table (SST) with Patient
Prevention of Pressure Injuries (PI) is significantly more cost-effective than management/treatment of a PI.

Cost to treat a SCI Patient over a life time...

$1.1 to $5 Million

Source: Kruger, 2013.
In 2008, the Healthcare Cost and Utilization Project (HCUP) / Agency for Health Care Research and Quality recorded 5,000 total hospital stays in the United States with pressure ulcers (now known as Pressure Injuries or PI) as the primary diagnosis for admission.

- Greater than **50%** of acute SCI patients experience *at least 1 complication* during their *initial hospitalization*.
- More often than not, it is a **skin complication**, aka *(PI)* pressure injury
- Source: Stricsek, 2017
In 2008, new Medicare ruling stated: HAPI of Stage 3 or greater will be paid for by the facility where it occurred.

Medicare no longer pays for...HAPIs of stage 3 or >
**TERMS & DEFINITIONS**

**Interface Pressure**: Pressure exerted on the arterioles leading to tissue hypoxia/necrosis

**Pressure Mapping**: Numerical assessment of interface pressures that would demonstrate potential for PI formation

- Pressure is measured by mm/Hg

**Capillary Closing Pressure**: 32 mm/Hg or greater over prolonged period of time results in tissue hypoxia/necrosis (PI development)

- PI development can occur in two hours or less in a SCI patient
Spinal Cord Injury (SCI)

Capillary Closing Pressure

Interface Pressure

Pressure Injury (PI)

Pressure Ulcer (PU)

Prevention Risk Factors

Spinal Stabilization Table (SST)
ABBREVIATIONS

- **FIHDFC**: Four Inch High-Density Foam Cushion
- **SST**: Spinal Stabilization Table
- **PI**: Pressure Injury
- **PU**: Pressure Ulcer
- **HAPI**: Hospital-Acquired Pressure Injury
- **CAPI**: Community-Acquired Pressure Injury
- **SCI**: Spinal Cord Injury
Utilization of a *replacement FIHDFC* in the seat hatch of the SST greatly reduces the incidence of PI development in the acute adult patient admitted with an unstable spine with or without a SCI.
49 acute adult patients with unstable spinal injuries with or without SCI
TICU North
9 patients

TICU South
39 Patients

Research Units
STUDY TIME FRAME

February 2012 - January 2017 (59 months)
EXTRINSIC FACTORS + INTRINSIC FACTORS = PI FORMATION
EXTRINSIC FACTORS:

Moisture...

Pressure...

Time...

\[
\text{pressure} = \frac{\text{force}}{\text{area}}
\]
**INTRINSIC FACTORS:**

- Diabetes
- Vascular deficiencies (PAD, PVD)
- Cardiac deficiencies (CHF, CAD)
- Obesity
SCI patients exhibit interface pressures 6 - 46% higher than patients without a SCI.

Source: Striscek, 2017.
PROLONGED INTERFACE PRESSURES GREATER THAN 32 MM/HG ARE OFTEN related to the *decrease in the capillary blood flow to the tissues RESULTING IN DEVELOPMENT OF Pressure Injuries*.

Source: Striscek, 2017.
Pressure mapping as determined by mm/Hg/color spectrometry
INTERPRETATION OF PRESSURE MAPPING/COLOR IN MILLIMETERS OF MERCURY=MM/HG

- **Red**: 180 mm/Hg of pressure
- **Orange**: 140-160 mm/Hg
- **Yellow**: 120-140 mm/Hg
- **Green**: 80-120 mm/Hg
- **Blue**: 20-60 mm/Hg
- **Grey**: 0-20 mm/Hg
High loads for short duration
“OR” Low loads for long duration

= Pressure Injury (PI) formation...

Source: Edsberg, 2016.
STAGE 1

- Non-blanchable
- Skin is intact

Source: Edsberg, 2016.
STAGE 2

- Intact blister or unroofed/open blister over a bone

Source: Edsberg, 2016.
STAGE 3

- Damage extends to the muscle but not through the muscle
- No muscle is visible
- Slough, fibrin may be present
- No bone, muscle or tendon exposure

Source: Edsberg, 2016.
STAGE 4

- Muscle & /or bone &/or tendon exposed
- Necrotic slough, fibrin, eschar

Source: Edsberg, 2016.
Cannot see wound base to determine stage due to presence of slough and/or eschar.

Source: Edsberg, 2016.
Frequently leads to *litigation*

Source: Edsberg, 2016.
THE STUDY...
FACTORS REVIEWED IN STUDY DATA:

- MRN (Medical Record Number of the Patient)?
- Age/Gender?
- Mode of Injury? Acute SCI with or without SCI?
- Level of Injury?
- Dates On/Off the SST?
- Number of Days on the SST?
- Use of SST Cushion?
- Use of FIHDFC?
- PI Development over Sacral/Coccyx Region & Stage of PI?
RESULTS...
Chi-Square Tests

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
<th>Exact Sig. (2-Sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>4.561(^a)</td>
<td>1</td>
<td>.033</td>
<td></td>
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<tr>
<td>Continuity Correction(^b)</td>
<td>2.989</td>
<td>1</td>
<td>.084</td>
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<tr>
<td>Likelihood Ratio</td>
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<td>.008</td>
<td></td>
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<tr>
<td>Fisher's Exact Test</td>
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<td></td>
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<td>.043</td>
<td>.031</td>
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<tr>
<td>Linear-by-Linear Association</td>
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<tr>
<td>N of Valid Cases</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Denotes cells (25.0%) with expected count less than 5. The minimum expected count is 2.63.

\(^b\) Computed only for a 2x2 table.
Paraplegia: 4-inch Cushion

* PI Crosstabulation

<table>
<thead>
<tr>
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<th>PI</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4” Cushion</td>
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<td>11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>11</td>
<td>28</td>
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</table>
### Chi-Square Tests

<table>
<thead>
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<th>Value</th>
<th>df</th>
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<th>Exact Sig. 2 sided</th>
<th>Exact Sig. 1 sided</th>
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</thead>
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<tr>
<td>Pearson Chi-Square</td>
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<tr>
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<td>.055</td>
<td>.033</td>
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<tr>
<td>Linear-by-Linear Association</td>
<td>4.765</td>
<td>1</td>
<td>.029</td>
<td></td>
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</tr>
<tr>
<td>N of Valid Cases</td>
<td>28</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**a. PARATETRA = Para**

**b.** 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.36.
### Statistical Analysis:

Four Inch High-Density Foam Cushion (FIHDFC)*
PI Cross tabulation

<table>
<thead>
<tr>
<th></th>
<th>PI</th>
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</thead>
<tbody>
<tr>
<td>FIHDFC</td>
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<td>25</td>
<td>14</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>14</td>
<td></td>
<td>48</td>
</tr>
</tbody>
</table>
This result is **SIGNIFICANT** at the $p < 0.05$ level, indicating relationship between the cushion used and pressure injuries.

- Future research should include a greater sample size.

- Relative Risk data could not be computed due to a zero value in the crosstab table.

- This next set of analyses examines paraplegic versus tetraplegic injuries separately and features the same analysis as the one above but separated into subgroups.
FINAL ANALYSIS:

“This result is significant at the p< 0.05 level, indicating relationship between the cushion used and pressure injuries (PI).” Dr. David Chesire, (Statistician)
NINE (9) patients received the FIHDFC replacement cushion = 0 PI developed.

THIRTY-NINE (39) patients utilized the SST cushion w/o replacement of FIHDFC, 36% with /PI of Stage 2 or >
REFERENCES
AVAILABLE/HANDOUT
UPON
REQUEST
Dziękuję

Muchas Gracias

THANK YOU

Danke

THANK YOU

Choukrane

Abrigado

Grazie

Dziękuję

Баярлалаа

Takk

Danke

THANK YOU

Choukrane

Abrigado

Grazie

Dziękuję
THANK YOU FOR YOUR ATTENTION!