Incidence of Traumatic Spinal Injury Following Public Policy Update on Moped Usage in South Carolina

Samuel Wood, Danielle Harpen, Chase Gauthier, Richard Bidwell and Gregory Grabowski

This information is current as of April 30, 2025.

Email Alerts   Receive free email-alerts when new articles cite this article. Sign up at:
http://ijssurgery.com/alerts

Incidence of Traumatic Spinal Injury Following Public Policy Update on Moped Usage in South Carolina

SAMUEL WOOD, MD[1]; DANIELLE HARPEN, BS[2]; CHASE GAUTHIER, MD[1]; RICHARD BIDWELL, MD[1]; AND GREGORY GRABOWSKI, MD[1]

[1]*Department of Orthopedic Surgery, Prisma Health – Midlands, Columbia, SC, USA;* [2]*Department of Orthopedic Surgery, University of South Carolina School of Medicine Columbia, Columbia, SC, USA*

ABSTRACT

Background: Electric scooters and mopeds have become prevalent modes of transportation for many Americans. On 19 November 2018, South Carolina implemented a law mandating the registration of these vehicles with the South Carolina Department of Motor Vehicles, enabling better regulation of moped and scooter drivers on the roads. This study aims to investigate whether the incidence of vertebral fractures and spinal cord injuries related to moped and scooter accidents decreased after the passage of this 2018 South Carolina law.

Methods: Retrospective data from a cohort of 350 patients, 239 before ("prelaw") and 111 after the law ("postlaw") was implemented, seeking care at a level 1 trauma center for moped or scooter-related spinal injuries between January 2014 and December 2022 were analyzed. Differences in the incidence of vertebral fractures and spinal cord injuries before and after the passage of the South Carolina law were calculated. Vertebral fractures were categorized by location on the spine pre- and postlaw. χ^2, Wilcoxon rank sum, and Shapiro-Wilk tests were employed to compare variables between groups.

Results: A total of 60 traumatic vertebral fractures (47 prelaw and 13 postlaw) and 7 spinal cord injuries involved moped accidents. There was no significant difference in the incidence rate of vertebral fractures (19.7% vs 11.7%, $P = 0.09$) or spinal cord injuries (2.9% vs 0%, $P = 0.1$) between those injured prelaw and postlaw, although there were significant differences between the groups in age (43.2 vs 47.4, $P < 0.01$) and incidence of men injured (87.9% vs 95.5%, $P = 0.03$). Multivariable logistic regression demonstrated suffering a moped-related traumatic injury before the implementation of the 2018 South Carolina law (OR = 2.08, 95% CI: 1.09–4.23, $P = 0.03$) and an increase in age at the time of injury (OR = 1.03, 95% CI: 1.01–1.05, $P = 0.01$) were independently associated with an increase in the odds ratio of suffering traumatic vertebral fractures following a moped accident when controlling for multiple confounding factors.

Conclusion: Before the implementation of a 2018 South Carolina law that increased moped regulations, moped drivers had a significantly higher odds ratio for suffering a traumatic vertebral fracture compared with after the implementation of the law when controlling for confounding factors. These findings suggest that public policy surrounding moped use may contribute to a decrease in the overall odds of suffering vertebral fractures resulting from moped use and emphasize the need for continual updates to public policy with public safety in mind. This is not only important from a standpoint of patient safety, but it also helps to decrease the amount of health care resources and dollars used.

Clinical Relevance: Implementation of public policy surrounding use of mopeds may decrease overall odds of vertebral fractures, which may decrease subsequent health care resource utilization.

Level of Evidence: 3.

Cervical Spine

Keywords: public policy, moped, e-Scooter, spinal injury, South Carolina, cervical injury, thoracic injury, lumbar injury

INTRODUCTION

Scooters and mopeds represent a convenient and dependable mode of transportation widely embraced by many Americans.[1] The proliferation of scooter-sharing apps, such as Lime and Spin, has contributed to the increased accessibility of moped usage.[2] Moreover, certain states, such as Virginia and North Carolina, do not mandate licensure for operating mopeds, rendering them an attractive option for individuals with suspended or no licenses.[3] As the presence of mopeds and scooters on roads has surged, a corresponding rise in scooter-related trauma and emergency room admissions has been anticipated.[4] Since 2007, there has been a noticeable uptick in moped accidents associated with severe injuries.[4] Additionally, studies indicate that moped-related accidents more frequently involve drivers under the influence of alcohol compared with other vehicular accidents.[5]

On 18 November 2018, South Carolina implemented a law requiring riders to register their mopeds as motor vehicles with the South Carolina Department of Motor

Vehicles.[6] This legislation empowers law enforcement agents to issue tickets and citations to moped drivers for traffic violations. Moreover, the age requirement for operating these vehicles increased from 14 to 15 years.[6] Driving under the influence charges for moped riders are now adjudicated in South Carolina courts.[6] Prior studies have investigated the correlation between the enforcement of vehicle safety measures and the severity of injuries, with the findings indicating that states with legislation addressing road safety contribute to reducing the morbidity of injuries sustained during accidents, thereby enhancing riders' chances of survival.[7]

Traumatic spinal cord injuries and vertebral fractures are common injury patterns, with an estimated incidence of 18,000 and 621,000 per year, respectively, in the United States.[8–11] The economic burden related to the treatment of vertebral fractures is high, with patients suffering a vertebral fracture expected to incur $44,258 in health care costs.[11] In those with a traumatic spinal cord injury, health care costs in the first year are estimated at $1.3 million, with an additional cost of $228,450 each subsequent year.[8] Additionally, spinal cord injuries and vertebral fractures are common injury patterns in moped accidents.[12] Given the substantial injuries linked with moped use and the high health care costs associated with treating these injuries, this study seeks to examine whether the 2018 moped law was connected to a reduction in the rate and type of spine-related trauma experienced by moped and scooter riders at a level 1 trauma center. The implications of these findings will contribute to shaping public policy and injury prevention strategies.

METHODS

After obtaining Institutional Review Board approval, a retrospective review of 350 patients who sustained moped- or scooter-related spinal injuries at a single level 1 trauma center, from 1 January 2014 to 31 December 2022 was conducted. Patients injured due to motorcycle use were excluded from the study. Demographic data, including body mass index, age, race, sex, ethnicity, and incidence of spinal cord injuries and vertebral fractures, were collected. Patient vertebral fractures were categorized into 3 main groups: cervical, thoracic, or lumbar injuries. These data were compared between patients injured before and after the implementation of the 18 November 2018 law regarding the increased regulation surrounding the use of mopeds in South Carolina, which is subsequently referred to as "prelaw" and "postlaw." Also, the proportion of spinal moped injuries from the trauma registry before and after the moped law

Table 1. Demographic information of trauma cases involving a moped or scooter before and after increased regulation.

Characteristic	Prelaw (N = 239)	Postlaw (N = 111)	P
Age, y, mean (SD)	43.2 (15)	47.4 (12.9)	**0.01**
BMI, mean (SD)	26.5 (5.5)	27.5 (6.4)	0.3
Race, n (%)			
White	130 (54.4)	63 (56.8)	
Black	91 (38.1)	41 (36.9)	
Other	18 (7.5)	7 (6.3)	
Gender, n (%)			
Men	210 (87.9)	106 (95.5)	**0.03**
Women	29 (12.1)	5 (4.5)	
Patient ethnicity, n (%)			
Not Hispanic or Latino	234 (97.9)	107 (96.4)	0.47
Hispanic or Latino	5 (2.1)	4 (3.6)	
Incidence of vertebral fractures, n (%)			
Total	47 (19.7)	13 (11.7)	0.09
Cervical	25 (10.5)	10 (9)	0.8
Thoracic	16 (6.7)	3 (2.7)	0.19
Lumbar	16 (6.7)	2 (1.8)	0.07
Incidence of spinal cord injuries, n (%)			
Total	7 (2.9%)	0 (0%)	0.1

Abbreviation: BMI, body mass index.
Note: Bolded values indicate a statistically significant finding with $P < 0.05$.

was examined. χ^2 tests were utilized to compare categorical data and the Student's t test or Wilcoxon Rank Sum test for continuous data, depending on the normality of the data. The normality of the data was assessed using the Shapiro-Wilk test. Additionally, multivariable logistic regression analysis was utilized to control for confounding variables.

RESULTS

Among the 350 total trauma cases involving a moped or scooter treated at a level 1 trauma center from 2014 to 2022, 239 cases occurred prelaw and 111 occurred postlaw. The majority of patients in the prelaw and postlaw groups were white (54.5% and 56.8%, respectively) and men (87.9% and 95.5%, respectively). In comparing demographic information between the 2 study populations, it was found that those treated postlaw were significantly more likely to be men (95.5% vs 87.9%, $P = 0.03$) and older (47.4 vs 43.2 years, $P = 0.01$) compared with those treated prelaw (Table 1).

There were 60 recorded incidences of vertebral fractures following traumatic moped injuries, with 47 occurring in the prelaw group and 13 occurring in the postlaw group. In comparing the prevalence of vertebral fractures between patients in the prelaw and postlaw groups, there was found to be no significant difference in the prevalence of total vertebral fractures (19.7% vs 11.7%, $P = 0.09$), cervical vertebral fractures (10.5% vs 9%, $P = 0.8$), thoracic vertebral fractures (6.7% vs

Table 2. Demographic information by vertebral fracture involving a moped or scooter.

Characteristic	Cervical (*N* = 35)	Thoracic (*N* = 19)	Lumbar (*N* = 18)	*P*
Prelaw, *n* (%)	25 (71.4)	16 (84.2)	16 (88.9)	0.31
Postlaw, *n* (%)	10 (28.6)	3 (15.8)	2 (11.1)	
Age, y, mean (SD)	48.7 (13.6)	51.5 (13)	46.9 (17.3)	0.62
BMI, mean (SD)	27.1 (6.3)	28.7 (8)	27.3 (5.4)	0.72
Race, *n* (%)				
White	17 (48.6)	16 (84.2)	11 (61.1)	<0.01
Black	18 (51.4)	2 (10.5)	5 (27.8)	
Other	0 (0)	1 (5.3)	2 (11.1)	
Gender, *n* (%)				
Men	32 (91.4)	18 (94.7)	13 (72.2)	0.11
Women	3 (8.6)	1 (5.3)	5 (27.8)	
Patient ethnicity, *n* (%)				
Not Hispanic or Latino	35 (100)	19 (100)	16 (88.9)	0.06
Hispanic or Latino	0 (0)	0 (0)	2 (11.1)	

Abbreviation: BMI, body mass index.

Note: Bolded values indicate a statistically significant finding with *P* < 0.05.

2.7%, *P* = 0.19), and lumbar vertebral fractures (6.7% vs 1.8%, *P* = 0.07; Table 2). In comparing demographic information between those with a vertebral fracture, it was found that those with cervical fractures were significantly more likely to be African American compared with those with thoracic or lumbar vertebral fractures (51.4% vs 10.5% vs 27.8%, *P* < 0.01).

There were a total of 7 traumatic spinal cord injuries recorded following a moped accident, with all 7 injuries occurring prelaw and no injuries occurring postlaw. In comparing the prelaw and postlaw groups, there was no significant difference in the prevalence of traumatic spinal cord injuries (2.9% vs 0%, *P* = 0.1).

Univariate, unadjusted logistic regression analysis was utilized to identify patient-specific factors that affected the incidence of traumatic vertebral fractures and spinal cord injuries following a moped injury for use in the multivariable model. An increase in age was associated with an increased odds ratio (OR) for total vertebral fractures (OR = 1.002, *P* = 0.04), white race was associated with an increased OR for thoracic vertebral fracture (OR = 1.07, *P* = 0.01), African American race was associated with a decreased OR for thoracic

vertebral fractures (OR = 0.94, *P* = 0.01), being a woman was associated with an increased OR for lumbar vertebral fractures (OR = 1.11, *P* = 0.01), and Hispanic or Latino ethnicity was associated with an increased OR for lumbar vertebral fractures (OR = 1.19, *P* = 0.02; Table 3). No factors were significant predictors for an increased OR for spinal cord injuries. Based on these findings, prelaw vs postlaw, age as a continuous factor, white race, African American Race, female gender, and Hispanic or Latino ethnicity were included in our multivariable analysis for vertebral fracture.

Multivariable logistic regression analysis demonstrated that suffering a moped-related traumatic injury before the implementation of the 2018 South Carolina law (OR = 2.08, 95% CI: 1.09–4.23, *P* = 0.03) and an increase in age at the time of injury (OR = 1.03, 95% CI: 1.01–1.05, *P* = 0.01) were independently associated with an increased OR for a traumatic vertebral fracture following a moped accident when controlling for multiple confounding factors (Table 4). In a subanalysis, an increase in age was independently associated with an increased odds ratio for thoracic vertebral fracture (OR = 1.04, 95% CI: 1.01–1.08, *P* = 0.02), and being

Table 3. Univariate logistic analysis of patient variables leading to traumatic spinal fractures involving a moped or scooter.

Characteristic	Total		Cervical		Thoracic		Lumbar	
	OR	*P*	OR	*P*	OR	*P*	OR	*P*
BMI (continuous)	1.002	0.57	1.001	0.86	1.002	0.21	1.001	0.77
Prelaw or not	1.08	0.06	1.02	0.66	1.04	0.12	1.05	0.05
Postlaw or not	0.92	0.06	0.98	0.66	0.96	0.12	0.95	0.05
Age (continuous)	**1.002**	**0.04**	1.002	0.08	1.002	0.03	1.001	0.49
Age >50 y	1.06	0.18	1.04	0.19	1.04	0.08	1.01	0.59
White	1.02	0.57	0.97	0.42	**1.07**	**0.01**	1.01	0.59
Black	0.99	0.83	1.06	0.08	**0.94**	**0.01**	0.98	0.37
Other	0.95	0.48	0.9	0.08	0.98	0.75	1.03	0.5
Women	1.04	0.57	0.99	0.82	0.97	0.5	**1.11**	**0.01**
Ethnicity	1.05	0.68	0.9	0.31	0.95	0.47	**1.19**	**0.02**

Abbreviation: BMI, body mass index.

Note: Bolded values indicate a statistically significant finding with *P* < 0.05.

Table 4. Multivariate logistic analysis for independent predictors of traumatic vertebral fractures involving a moped or scooter.

Characteristic	OR	95% CI	P
Prelaw	**2.08**	**1.09–4.23**	**0.03**
Age	**1.03**	**1.01–1.05**	**0.01**
Female gender	1.47	0.54–3.62	0.42
White	3.34	0.63–61.71	0.25
Black	2.85	0.52–53.3	0.32
Hispanic or Latino	4.63	0.36–113.45	0.25

Note: Bolded values indicate a statistically significant finding with $P < 0.05$.

woman was independently associated with an increased OR for lumbar vertebral fracture (OR = 3.89, 95% CI: 1.05–13.02, P = 0.03) when controlling for potential confounding factors. No factors were significantly associated with an increased OR for cervical vertebral fractures (Tables 5–7).

DISCUSSION

Mopeds and scooters are widely accessible and popular forms of transportation for many Americans.[1] Before 2018, South Carolina had limited regulations governing the use of these vehicles on roadways. The implementation of the November 2018 South Carolina law mandated moped registration with the South Carolina Department of Motor Vehicles, holding riders accountable for roadway violations.[6] This study investigates the incidence and type of vertebral fractures and spinal cord injuries resulting from moped and scooter accidents at a level 1 trauma center.

This study found that moped drivers before the implementation of the South Carolina law in 2018 had a significantly higher OR of suffering a traumatic vertebral fracture as a result of a moped-use injury than moped drivers after the implementation of the 2018 law when controlling for confounding factors. This could be attributed to the fact that moped riders were not previously required to possess a valid license, making these vehicles an appealing choice for individuals with suspended licenses due to high-risk behavior or no license at all.[4,13,14] Additionally, a study in North

Carolina revealed that nearly half of the moped riders stopped by police were under the influence of alcohol while driving, and those found to be under the influence of alcohol were more likely to have repeat driving under the influence offenses compared with those who were not found to be intoxicated while driving.[5,13] The decrease in the odds of suffering traumatic vertebral fractures following the implementation of the 2018 South Carolina law could be associated with enhanced enforcement of traffic laws or a general reduction in the number of moped drivers. The new legislation also addresses possible loopholes related to driving under the influence violations. Therefore, these results suggest that public policies that address unsafe driving practices by moped and scooter riders may have contributed to a reduction in the OR of subsequent traumatic vertebral fractures because of moped use, which may in turn lead to a decrease in the overall health care cost burden associated with these injuries.

The study also found that an increase in age and female gender was independent predictors for an increased OR for thoracic and lumbar vertebral fractures, respectively. Interestingly, previous studies have identified the male gender as an independent risk factor for injury while operating a scooter or moped.[14,15] Other studies have shown that older individuals and women are more likely to suffer a higher injury severity score when experiencing trauma.[16] This has been attributed to increased comorbidities and lower bone density in these patient populations.[16] It is possible that among those

Table 5. Multivariate logistic analysis for independent predictors of traumatic cervical vertebral fractures involving a moped or scooter.

Characteristic	OR	95% CI	P
Prelaw	1.31	0.61–2.99	0.5
Age	1.02	0.99–1.05	0.1
Female gender	1.17	0.26–3.84	0.81
White		NA due to singularities	
Black		NA due to singularities	
Hispanic or Latino	0.99	0.00–2.83	>0.99

Abbreviation: NA, not applicable.
Note: Bolded values indicate a statistically significant finding with $P < 0.05$.

Table 7. Multivariate logistic analysis for independent predictors of traumatic lumbar vertebral fractures.

Characteristic	OR	95% CI	P
Prelaw	4.15	1.1–27.12	0.07
Age	1.03	0.99–1.06	0.14
Female gender	**3.89**	**1.05–13.02**	**0.03**
White		NA due to singularities	
Black		NA due to singularities	
Hispanic or Latino		NA due to singularities	

Abbreviation: NA, not applicable.
Note: Bolded values indicate a statistically significant finding with $P < 0.05$.

Table 6. Multivariate logistic analysis for independent predictors of traumatic thoracic vertebral fractures involving a moped or scooter.

Characteristic	OR	95% CI	P
Prelaw	3.02	0.96–13.39	0.09
Age	**1.04**	**1.01–1.08**	**0.02**
Female gender	0.65	0.03–3.74	0.69
White	1.32	0.23–25.12	0.8
Black	0.2	0.02–4.55	0.21
Hispanic or Latino		NA due to singularities	

Abbreviation: NA, not applicable.
Note: Bolded values indicated a statistically significant finding with $P < 0.05$.

involved in moped or scooter accidents, older patients and women are more likely to suffer spinal trauma due to the aforementioned risk factors. Other explanations could be that the 2018 law raised the age required to drive mopeds, resulting in an overall increase in the age of those who experienced injury, as demonstrated in this study. Further investigation into the relationship between female gender and spinal trauma from moped accidents may be needed to fully understand the role these 2 variables play with one another.

An unexpected finding of this study concerned the influence of race on the incidence of vertebral fractures following moped injuries. It was found that patients with cervical vertebral fractures were significantly more likely to be African American compared with those with thoracic or lumbar vertebral fractures and that being white and African American was associated with an increase and decrease, respectively, in the OR for suffering a thoracic vertebral fracture. White patients have consistently been shown to account for many moped injuries recorded, including in this current study.[4,15] It is worth noting, however, that this association between race and thoracic vertebral fractures was no longer present when controlling for confounding factors. Instead, age became a significant independent predictor of an increased OR for thoracic vertebral fractures. As such, it is most likely that white patients with thoracic vertebral fractures tended to be older than African American patients, thereby leading to the observed findings. Overall, we do not believe that a patient's race directly influences their injury pattern following moped accidents, although our study presents interesting findings, which may require further investigation.

Several limitations exist in this study, including reliance on electronic medical record data in the retrospective review, introducing the potential for error through misclassification of injury via the International Classification of Diseases, 10th Revision, codes. These possible errors could potentially influence the results and interpretation of the data. Additionally, the study was limited to 1 location at a level 1 trauma center, making the generalizability of the data limited. Finally, it is unknown whether the use of mopeds and scooters remained consistent from prelaw to postlaw and whether the COVID-19 pandemic may have affected the total utilization of mopeds and scooters postlaw, which limits the generalizability of the data.

Future research directions may involve expanding the review to multiple states if moped and scooter laws are implemented in other areas. The focus may also be extended to other modes of transportation, including boats, motorcycles, cars, and bicycles, to determine how the implementation of public policy influences the incidence of spinal-related trauma.

CONCLUSION

This study that, when controlling for confounding variables, moped drivers before the implementation of an 18 November 2018 South Carolina law focused on increasing the regulations for moped users had significantly higher OR for suffering a traumatic vertebral fracture compared with moped users after the implementation of the law. These findings suggest that public policy surrounding moped use may contribute to a decrease in the overall odds of vertebral fractures resulting from such use. Future updates to the law could be crucial for further addressing driver accountability and safety, potentially leading to a greater reduction in injury severity and associated hospital costs.

REFERENCES

1. Shared Micromobility in the U.S.: National Association of City Transportation Officials. https://nacto.org/shared-micromobility-2018/. Accessed December 28, 2020.

2. Lime, Bird, Spin and Super Pedestrian Partner to Share Best Practices for Regulating E-scooters and E-bikes in North American Cities. Policy Update: May 15, 2023. Published Online May 15, 2023. 2023. https://www.li.me/blog/lime-bird-spin-and-superpedestrian-partner-to-share-best-practices-for-regulating-e-scooters-and-e-bikes-in-north-american-cities. Accessed January 10, 2024.

3. Miggins M, Lottenberg L, Liu H, Moldawer L, Efron P, Ang D. Mopeds and scooters: crash outcomes in a high traffic state. *J Trauma*. 2011;71(1):217–222. doi:10.1097/TA.0b013e318208f874

4. Bandzar S, Gupta S, Atallah H. Increase in moped injuries requiring emergency care. *Am J Emerg Med*. 2016;34(10):2000–2002. doi:10.1016/j.ajem.2016.07.052

5. Braun BM, Gries LM, Hildreth AN, Miller AN. Moped collisions among patients with revoked drivers' licenses are a significant public health problem: a retrospective cohort study. *Am Surg*. 2014;80(8):792–795.

6. South Carolina Department of Public Safety, South Carolina's Highway and Safety Performance Plan. http://www.nhtsa.gov/links/statedocs/FY14/FY14HSPs/SC_FY14HSP.pdf. Accessed December 28, 2023.

7. Busko A, Hubbard Z, Zakrison T. Motorcycle-helmet laws and public health. *N Engl J Med*. 2017;376(13):1208–1209. doi:10.1056/NEJMp1615621

8. Traumatic Spinal Cord Injury Facts and Figures at a Glance. https://www.nscisc.uab.edu/public/Facts%20and%20Figures%202023%20-%20Final.pdf. Accessed January 11, 2024.

9. Devivo MJ. Epidemiology of traumatic spinal cord injury: trends and future implications. *Spinal Cord*. 2012;50(5):365–372. doi:10.1038/sc.2011.178

10. Dong Y, Peng R, Kang H, et al. Global incidence, prevalence, and disability of vertebral fractures: a systematic analysis of the global burden of disease study 2019. *Spine J*. 2022;22(5):857–868. doi:10.1016/j.spinee.2021.12.007

11.   Beschloss AM, Taghlabi KM, Rodriguez DA, et al. Demographic and economic trends in vertebral fracture surgeries throughout the United States. *N Am Spine Soc J*. 2022;12:100175. doi:10.1016/j.xnsj.2022.100175

12.   Kent T, Miller J, Shreve C, Allenback G, Wentz B. Comparison of injuries among motorcycle, moped and bicycle traffic accident victims. *Traffic Inj Prev*. 2022;23(1):34–39. doi:10.1080/15389588.2021.2004311

13.   Christmas AB, Brintzenhoff RA, Schmelzer TM, Head KE, Sing RF. MOPEDS: motorized objects propelling ethanol drinking subjects. *Am Surg*. 2011;77(3):304–306. doi:10.1177/000313481107700318

14.   Shichman I, Shaked O, Factor S, Weiss-Meilik A, Khoury A. Emergency department electric scooter injuries after the introduction of shared e-scooter services: a retrospective review of 3,331 cases. *World J Emerg Med*. 2022;13(1):5–10. doi:10.5847/wjem.j.1920-8642.2022.002

15.   Aizpuru M, Farley KX, Rojas JC, Crawford RS, Moore TJ, Wagner ER. Motorized scooter injuries in the era of scooter-shares: a review of the national electronic surveillance system. *Am J Emerg Med*. 2019;37(6):1133–1138. doi:10.1016/j.ajem.2019.03.049

16.   Gioffrè-Florio M, Murabito LM, Visalli C, Pergolizzi FP, Famà F. Trauma in elderly patients: a study of prevalence, comorbidities and gender differences. *G Chir*. 2018;39(1):35–40. doi:10.11138/gchir/2018.39.1.035

Corresponding Author: Chase Gauthier, Department of Orthopedic Surgery, Prisma Health – Midlands, 2 Medical Park Rd, Suite 404, Columbia, SC, 29203, USA; chase.gauthier@und.edu