CONCLUSION

ACL injuries are very common in the family practice setting. As the population becomes more active, these injuries will continue to be encountered by primary care physicians. A thorough understanding of the anatomy, presentation, evaluation, and management of these injuries will ensure a functional and healthy quality of life. Further research is needed to address the most effective methods in preventing and managing these injuries.

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REVIEW ARTICLE

Ultimate Fighting Championship Injuries; A Two-Year Retrospective Fight Injury Study

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KEYWORDS:

MMA
UFC
Ring Side Physician
Injuries
Fighter

Purpose: This epidemiologic study gives insight on management of fighters both in and out of the ring.

Methods: Data from 304 professional fighters in 152 fights were included.

Study Selection: The Fighters' Complaints, Physician Diagnosis, Imaging Results, and mechanism of win/loss were tabulated. Each fighter had a maximum of 4 injuries.

Data Extraction: All data was summated & either a Fishers Exact Test or Chi-Squared analysis was performed on individual injuries and fight outcome.

Results: 200 (66%) of the fighters were uninjured compared to 102(33%). The majority of injuries were soft tissue in nature. 43 x-rays, 7% found new fractures and 34 CTs confirmed 13 facial bone fractures and no subdural, epidural or intraparenchymal bleeds were observed. Three outcomes had a substantial increase in injury incidence; TO (armbar) 58.3% (7/12), TKO 52.9% (27/51), decisions 46.8% (37/79). Statistically significant injury rates were seen in TKO/KO compared to other outcomes; 1/3 of the total injuries occurred (9.27% of 33%, p= 0.004), 78% of total facial bone fracture (p=<0.001) & 83% of the total eye injuries (p<0.001). 34 (11.7%) competitors had CT Scans; 18 (52.9%) were negative, 13 (38.4%) identified facial bone fractures.

INTRODUCTION

Mixed Martial Arts (MMA) has recently seen an explosion in popularity worldwide. MMA is a full contact combat sport involving a variety of strikes, kicks and technical maneuvers including chokes and torsions in competitions. MMA encompasses boxing, wrestling and a variety of marital arts in competition. Open gloves, exposing the fingers and palms are used in competition in comparison to a closed glove used in boxing. Typical glove weight in MMA competition ranges from 4-6 ounces, whereas gloves worn in professional boxing typically weigh 10-12 ounces. It is conventional knowledge, albeit without statistical support, that the lighter the glove, the higher the velocity and impact of the strike. An array of minor and potentially serious injuries can occur in the ring during an MMA bout.

The Ultimate Fighting Championship (UFC), initially founded in 1993, has the lion share of both professional fighter pool and national/international fanfare. The UFC solidified their international power and fighter base with the acquisition of the World Extreme Cagefighting (WEC) in 2006, Pride in 2007, as well as Strikeforce in 2011 respectively[1]. Beginning in 2009, viewership of pay per view events surpassed the one million mark per televised event. Although the UFC typically does not release official numbers and statistics, it is public knowledge that they have experienced exponential growth in the last few years. Estimated earning of the UFC in 2008 exceeded $250 million, with a total estimated worth of $1 Billion[1].

As depicted above, the UFC's growth has drawn massive amounts of attention to the sport of MMA. Small and large MMA gyms have begun to open throughout the United States training interested participants the art of MMA. Due to the success of the UFC, both amateur and professional MMA events have become popular around the nation. MMA has created a new sporting venue that many medical personnel are unfamiliar with. Medical personnel's knowledge of the injuries incurred in the ring vary widely. Clearly, not only the UFC, but the sport that it has made mainstream, MMA, will have a huge impact in Sports Medicine today and in the future.

To date, only one MMA injury study has been published in the United States[3]. However, the following research is unique in the fact that only data obtained from UFC events was tabulated. UFC arguably is the highest level of MMA competition and is considered by most to have the most experienced fighters. At the time of authorship, no previous research has been published with specificity towards injury incurred in the UFC events.

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The goal of this study is to identify the injury patterns and frequency incurred during MMA fights at the professional level. This data was focused to help the medical professional in ringside management of the fighters and the events. Imaging including x-rays and Computed Tomography (CT Scans) were also analyzed to give further insight and reflection of the injuries. This data is aimed to help the ring side medical professional prepare for emergency situations and medical care for event coverage.

METHODS

Data was obtained directly from the Nevada Athletic Commission (NAC). All data was obtained solely from UFC events that took place in Las Vegas Nevada during a two-year period from January 01, 2007 through December 31, 2009.

Each fighter was examined immediately after the fight by a physician directly affiliated with the NAC. This occurred in the ring and/or the locker rooms. The physician then employed medical decision-making choices as to the care of the fighter. If the physician felt the fighter warranted further care not able to be given in the facilities the fighter was sent to the emergency department either via private transportation or ambulance.

A NAC physician recorded documentation of the medical diagnosis and decisions made in the facility. Emergency department documentation reviewed included chart notes, discharge documentation and radiology reports/images and were independent of the NAC. Mandatory suspension periods are given by the NAC after the exams, in which time the fighter cannot compete. These time frames range from 30, 45 and 60-day suspension depending upon the severity of the injury, injury location, fight result and possibly further consultation input. Individual fighters often fought in more then one bout during the two-year period studied. Thus, each time the fighter fought in a bout, his results were tabulated as an independent variable. No fighters' complaints or injuries were calculated as a cumulative variable. According to NAC documents, all UFC "events" had an average of 10 (min 9, max 18) fights per event. Although the UFC now has female competitors, all the data was obtained exclusively from male participants. Descriptive data points collected from the NAC included;

1. Fight outcome; win, loss, early stoppage, decision

2. If fighter lost, mechanism of loss; Knock Out (KO), Technical Knock Out (TKO), Tap outs (TO) specified in Arm/Ankle lock maneuver or a Choke-out technique

3. Anatomical location of the fighters' complaints

4. Ring-side physicians diagnosis

5. X-ray and CT Scan results from the Emergency Department

6. Follow up results from outside physicians.

Fighters occasionally had multiple injuries and complaints up to 4 separate injuries were allowed. This number was arbitrarily chosen due to one specific fighter whom reported 4 separate injury locations.

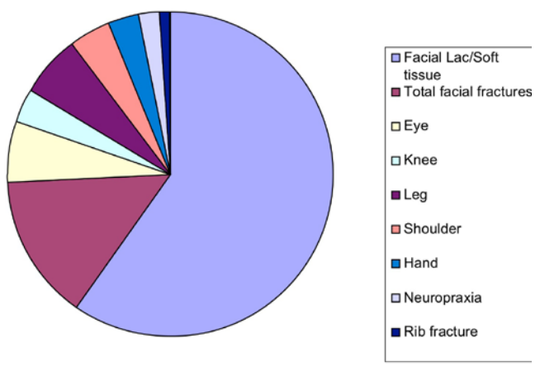
Subjects were then grouped by outcome of the fight including win, loss or decision. Following this, the total complaints, types of complaints and injuries were examined using Pearson's Chi-square tests where appropriate (expected frequency >5), otherwise Fisher's exact tests were used. Subjects were then divided by those with KO/TKO vs. all other decisions for the complaint and injury variables as previously stated for the Tap outs. All analyses used SAS for Windows 9.2, Cary, NC.

RESULTS

A total of 304 fighters (n=304) fought in 152 fights over the two-year study period. There were 15 events total that occurred in the two-year period. Of the 304 fighters, regardless of the outcome of the fight, 182 (60.3%) report no injury complaints in their bout, whereas 182 (39.7%) reported complaints of injury to the physician. Two fighters' lacked follow up and were excluded.

Fighter's complaints of anatomical locations described to the physician were as follows: 85 Face/Head (28.1%), 33 Leg/Ankle (11%), 15 Hand/Wrist (5%), 10 Knee (3.3%), 7 Arm/Elbow (2.3%) 7 Shoulder (2.3%), 4 Foot (1.3%), Chest/Rib 3 (1%), 4 Neck/C-Spine (1.3%), 2 Eye (0.6%).

Physicians diagnosed the following identifiable injuries: 58 Facial Laceration/Soft tissue (19.2%), total facial fractures of 14 (4.6%) of which 9 were nasal bone fractures (2.9%), 4 were orbital fractures (1.3%) and 1 was a mandible fracture (0.33%), 6 Eye (2%), 3 Knee (1%) including 1 of both an ACL tear and a Meniscus tear, 6 Leg(2%), 4 shoulder (1.3%), 3 hand (1%), 2 Neuropraxia (0.7%), 1 Rib Fracture (0.3%).

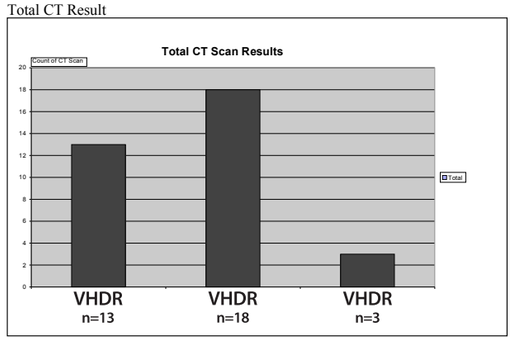


31 competitors (10.2%) were sent to the Emergency Department or requested to obtain x-rays. 10 competitors were lost to follow up. Of the 21 fighters with documented x-rays, 43 x-rays were obtained and reported to the NAC. 7% (3 new fractures) of the x-rays found new fractures, reciprocally 93% were negative.

34 (11.7%) competitors had CT Scans of the head and neck performed immediately after the events. 18 (52.9%) of the CTs were read as negative with no identifiable acute abnormality. 13 (38.4% of the CT scans) identified new facial bone fractures including orbital, nasal and mandible fractures as noted above. 3 (1%) had only superficial soft tissue findings with no other major bony structure changes as seen in figure 3. Of significance, 100% of the CT Scans showed no intracranial soft tissue or vascular abnormalities including subdural or epidural hematomas were identified.

Figure 3

Total CT Result



When comparing fight outcomes with injury rate, three fight outcomes had a substantial increase in injury incidence; Tap out via an Arm bar 58.3% (7/12), TKO 52.9% (27/51), decisions 46.8% (37/79), other rates were: Tap out via choke maneuver 29.4% (10/34), KO 20% (1/5), Tap out otherwise not specified 20% (1/5), Tap out via Ankle Lock 0% (0/3). Winning competitors were not spared injury; winning by Tap out retained an injury rate of 16.5% (18/109). (See Figure 2, Figure 4)

Figure 2

Percent Frequency of CT Scans by Fight Result

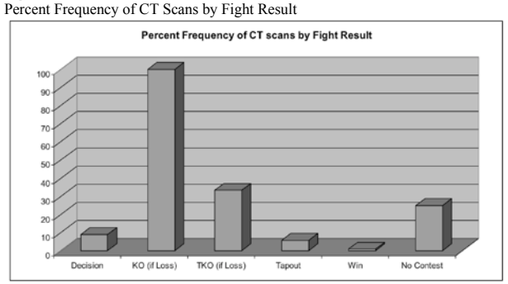
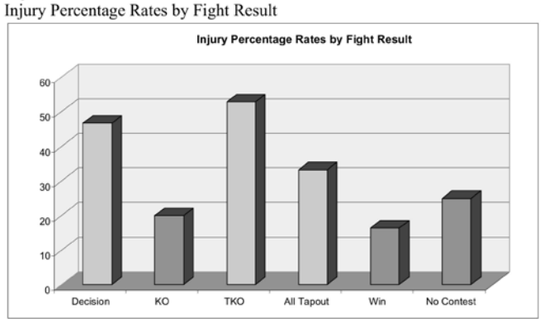


Figure 4

Injury Percentage Rates by Fight Result



Statistically significant increases in injury rates were observed when analyzing the various outcomes of the fight. If a fighter lost by TKO or KO, his injury rate (any location, any injury) was highest when compared to losing by any other method. Loss by TKO/KO when compared to all other outcomes resulted in 1/3 of the total injuries occurred (9.27% of 33% total injury rate, p= 0.004), 78% of total facial bone fractures (p=<0.001) & 83% of the total eye injuries (p<0.001).

Because of this glaring correlation between facial fractures with TKO and KO's a more detailed analysis was required. The relative risk of a fighter losing by TKO/KO and acquiring a facial bone fracture was nearly 20 fold when compared to all other outcomes regardless of win or lose. Specifically, all other fighters' (win or lose) incidence of facial bone fractures was 3/246 (1.2%), whereas, a loss by TKO/KO had an incidence of 11/56 (19.6%) (p<0.0001) with a RR=19.8 (95% CI=5.3, 73.8).

Correspondingly, a higher incidence of CT scans was obtained for those losing by TKO/KO. CT Scans were obtained in the following frequency; TKO/KO 22/56 (39.3%) and all other results (win or loss) CT-Scan 12/247 (4.9%) (p<0.0001) with a RR=12.7 95% CI= (5.75, 27.9).

Table 1	Not KO/TKO N=247	KO/TKO N=56	p-value
Any CT scan	12 (4.9%)	22 (39.3%)	**<0.0001**
Negative	8 (66.7%)	10 (45%)	
Brain/Neurovascular hemorraghes	0	0	
Facial bone	2 (16.7%)	11 (50%)	
Soft tissue	2 (16.7%)	1 (5%)	
Any complaint	82 (33%)	38 (68%)	**<0.0001**
Eye	1 (0.4%)	1 (1.8%)	0.34
Face	54(22%)	31 (55%)	**<0.0001**
Hand/wrist	11 (4.5%)	4 (7.1%)	0.49
LE	25 (10%)	8 (14%)	0.37
Knee	6 (2.4%)	4 (7.1%)	0.09
Foot	3 (1.2%)	1 (1.8%)	0.56
UE	5 (2.0%)	2 (3.6%)	0.62
Chest wall	1 (0.4%)	2 (3.6%)	0.09
C-Spine	3 (1.2%)	1 (1.8%)	0.56
Shoulder	5 (2.0%)	2 (3.6%)	0.62
Any injury	74 (30%)	28 (50%)	**0.004**
Facial bone fracture	3 (1.2%)	11 (19.6%)	**<0.0001**
ST facial injury	45 (18%)	13 (23%)	0.40
Eye injury	1 (0.4%)	5 (8.9%)	**0.0010**
Neuropraxia	2 (0.8%)	0	1.00
Knee internal Derangement	3 (1.2%)	0	1.00
Leg injury	6 (2.4%)	0	0.60
Shoulder injury	3 (1.2%)	1 (1.8%)	0.56
Hand injury	2 (0.8%)	1 (1.8%)	0.46

Table 1 compares all KO or TKO to all other fight results. The complaints and injuries are not mutually exclusive and each fighter could have more than 1 complaint and/or injury. When looking at complaints and/or injuries, an adjustment must be made for the multiple comparisons. A value<0.006 would then be required for statistical significance for each of the separate complaints and injuries. The KO/TKO group had more CT scans, more complaints and specifically statistically significant more face complaints, more injuries and specifically statistically significant more facial bone fractures and Eye injuries compared to all other fight results.

The above table compares all KO or TKO to all other fight results. The complaints and injuries are not mutually exclusive and each fighter could have more than one complaint and/or injury. When looking at complaints and/or injuries, an adjustment must be made for the multiple comparisons. A p-value of <0.006 would then be required for statistical significance for each of the separate complaints and injuries. The KO/TKO group had more CT scans, more complaints and statistically significant more face complaints, more injuries and more facial bone fractures and eye injuries compared to all other fight results.

Table 2	Not Tapouts N=249	Tapouts N=54	p-value
Any CT scan	31 (12.5%)	3 (5.6%)	0.15
Negative	17 (54.8%)	1 (33.3%)	
Facial bone	12 (38.7%)	1 (33.3%)	
Soft tissue	2 (6.5%)	1 (33.3%)	
Any complaint	101 (41%)	19 (35%)	0.45
Eye	2 (0.8%)	0	0.51
Face	77 (31%)	8 (15%)	0.016
Hand/wrist	14 (6%)	1 (2%)	0.49
LE	26 (10%)	7 (13%)	0.60
Knee	7 (3%)	3 (6%)	0.39
Foot	2 (0.8%)	2 (3.7%)	0.15
UE	5 (2.0%)	2 (3.7%)	0.61
Chest wall	3 (1.2%)	0	1.00
C-Spine	4 (1.6%)	0	1.00
Shoulder	3 (1.2%)	4 (7.4%)	0.021
Any injury	84 (34%)	18 (33%)	1.00
Facial bone fracture	13 (5.2%)	1 (1.9%)	0.48
ST facial injury	52 (21%)	6 (11%)	0.10
Eye injury	6 (2.4%)	0	0.60
Neuropraxia	1 (0.4%)	1 (1.9%)	0.33
Knee internal Derangement	1 (0.4%)	2 (3.7%)	0.08
Leg injury	3 (1.2%)	3 (5.6%)	0.07
Shoulder injury	2 (0.8%)	2 (3.7%)	0.15
Hand injury	3 (1.2%)	0	1.00

Table 2 compares all Tapouts to all other fight results. The complaints and injuries are not mutually exclusive and each fighter could have more than 1 complaint and/or injury. When looking at complaints and/or injuries, an adjustment must be made for the multiple comparisons. A value<0.006 would then be required for statistical significance for each of the separate complaints and injuries. Therefore, nothing can be considered statistically significant different between Not Tapouts and all Tapouts.

Table 2 compares all Tapouts to all other fight results. The complaints and injuries are not mutually exclusive and each fighter could have more than one complaint and/or injury. When looking at complaints and/or injuries, an adjustment must be made for the multiple comparisons. A value <0.006 would then be required for statistical significance for each of the separate complaints and injuries. Therefore, nothing can be considered statistically significantly different between Not Tapouts and all Tapouts.

DISCUSSION

After the institution of stricter regulations by the Nevada Athletic Commission (NAC) in 2001, the popularity of MMA soared[3]. These stricter guidelines and rules qualified MMA as a skilled sport in the public eye. Although CBS's 60 Minutes and the like of other media outlets have deemed this sport "barbaric," or as John McCain deemed as "human cock fighting," its popularity cannot be refuted.

Before the fighters compete in the professional level, a complete physical exam and baseline MRI of the head/neck must be obtained. Just as in any other professional sport, strict regulations in banned substances are enforced by state regulations. These competitors are high-level athletes; often they are decorated collegiate or professional athletes in other sports.

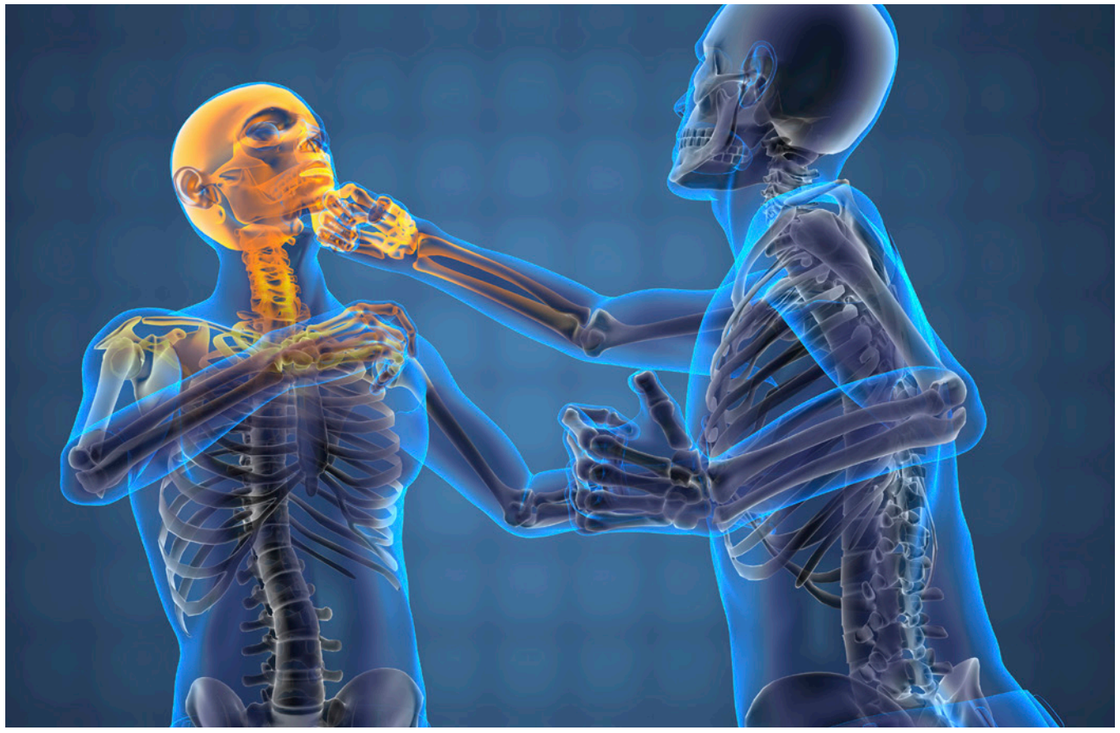
Although it may appear to spectators as though an injury rate would be exquisitely high, this study had an injury occurrence rate of 39.7 per 100 competitors, similar to boxing injury rates[6-9]. In related combat sports, injury rates per 100 competitors has been reported as low as 0.3 in martial arts to as high as 44.7 in competition boxing[4,10]. Published boxing injury rate observations specifically have ranged from 14.0 to 44.7 per 100 competitors [6-9]. This study showed similar total injury occurrence as boxing observations. The majority of observed injuries, 19.2% of the total 39.7% injury reports, were facial lacerations.

In this study, no structural injuries were observed to the cervical, thoracic or lumbar spine. Also, the CT Scans identified no intracranial or epidural hemorrhages, or any other abnormality in the brain's soft tissue and vascular structures directly related to competition. However, it should be noted that this is only a two-year window and does not exclude these serious implications from occurring.

Although this study showed observed injury rates similar to those of boxing and far fewer serious injuries than most would anticipate, the implications of multiple strikes to the head with smaller glove weight has yet to be comprehensively studied in MMA. Acute Brain Injury (ABI) including concussion, intracranial hemorrhages, parenchymal swelling, etc. has yet to be publicly studied in the UFC and MMA in general.

Acute Brain Injuries encompasses a reported 15.9% to 69.7% of the total injuries in boxing, and serious considerations must be made with the impacts of ABI in MMA[11]. As noted previously, competition gloves in MMA are open fisted and weigh 4-6 oz. compared to boxing's closed fisted 10-12 oz. gloves. Lighter glove weight has been shown to produce a higher velocity and acceleration of a strike. The strike velocity of a 6 oz. glove was 2.7 times faster then a 12 oz. glove. Likewise, it was postulated in this study, greater velocities and accelerations of a strike created greater forces delivered[12]. Although proper large biomechanical studies are lacking, these finding are important factors in MMA. Serious concussions were observed at a rate of 15.4 per 1000 athlete exposure in one published study to date in MMA[13]. ABI's undoubtedly occur in competition and the potential short and long-term affect of lighter glove weight must be taken into consideration in the acute setting of MMA injuries.

Chronic Brain Injuries also considered Chronic Traumatic Encephalopathy (CTE) or "Punch Drunk Syndrome" has yet to be addressed or studied given the youth of this sport. The affects of repetitive head strikes in boxing has been studied in only limited quantities. A.H. Roberts published what is widely thought as the most complete study to date with CTE in professional boxing. Roberts found that CTE was found in 17% of retired boxers[13]. Differences between MMA and boxing including the lighter glove weight, the probable higher velocity and accelerations of strikes, the large difference in delivered strikes in competitions and the fact that MMA fighters deliver and receive far less strikes to the head than boxers may affect long term outcomes. Both Acute and Chronic brain injury is area of importance that needs to be addressed and studied further.



CONCLUSION

Mixed Martial Arts has become internationally popular. The UFC is widely considered to be the highest level of competition in MMA in the United States, and internationally. To the average spectator this sport would appear to have an extremely high injury rate. The gloves in MMA competition are far smaller then those worn in boxing, the fighters strike with fists and elbows, kicks are employed to the head, body and legs and choke maneuvers are all used to win a match. However, when observing two years of fights that took place in Las Vegas from 2006-2008 an injury rate comparable to boxing was observed. Of the observed injuries the vast majority were facial soft tissue injuries. The serious injury rate observed was surprisingly low. Noteworthy was the fact that no deaths, intracranial hemorrhages, spinal cord or spinal injuries were observed during this time frame.

Although this is the first study to include data exclusively from the UFC, this two-year retrospective epidemiological study appears to be reflective of the acute injuries that occur in other combat sports. Acute and Chronic Brain Injuries were not able to be properly studied due to lack of data. Available data and management of neurological injuries in MMA will undoubtedly need more attention and research in the years to come as this sport continues to grow.

This study shed light on injury trends, locations and incidences of injuries at the highest level of MMA competition. This information should give ringside physicians or medical personal information when managing the competitors acutely.

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REVIEW ARTICLE

Osteopathic Considerations in the Management of Migraine in Pregnancy

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KEYWORDS:
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Many women frequently suffer from migraines and require pharmacotherapy to alleviate and control their symptoms. Unfortunately, many of these therapies are contraindicated when a woman becomes pregnant leaving her to find alternative treatments to manage her symptoms. Osteopathic medicine provides a unique perspective for treating migraines without the use of medication. Osteopathic manipulative treatment (OMT) can provide hands–on treatment to help alleviate migraine symptoms and improve the quality of life as a woman's body changes throughout her pregnancy.

INTRODUCTION

Headaches are the most frequent neurological disorder seen by family physicians. Approximately 90% of individuals will experience headaches in their lifetime, with the most common type being tension headaches. Migraines are the second most common type of headache, specifically migraine without aura, and tend to be more chronic and debilitating than tension headaches[1]. Migraines are caused by irritation of the trigeminal nucleus (see Figure 1). Irritation of the trigeminal nerve and its associated ganglion affects the release of vasoactive substances which in turn cause vasodilation of the large vessels underneath the dura mater causing pain[2]. The International Headache Society reports the average lifetime prevalence of migraines is 18%, with 1 in 5 women, and only 1 in 13 men, experiencing them in their reproductive years[1]. Prior literature on migraines has linked the high prevalence of migraines in females of childbearing age to hormonal influences[1, 3, 4]. Many females report their first migraine to coincide with the same year of menarche[1]. Additionally, migraines are commonly triggered by transitions in hormone balance of the menstrual cycle[1, 3-6]. One theory is that migraines may be precipitated secondary to a rapid drop in estrogen levels. This idea is further supported by the lower prevalence of migraines in pre-pubescent or post-menopausal females as well as those females whose migraines improve during pregnancy and rebound in the post-partum period[1, 3-5].

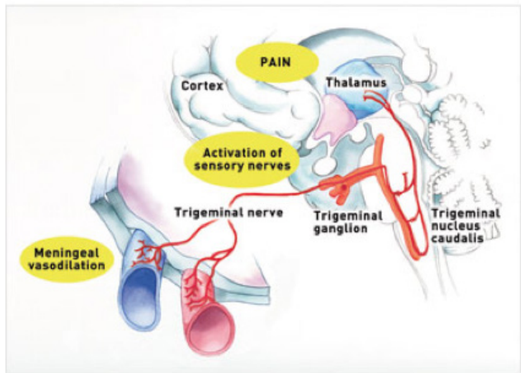

Figure 1 – Migraine pathway
Source: "Site of Migraine Generation: The Trigeminovascular System." Photo. The Role of CGRP and its Antagnists in Migraine. 10/2/2013. < http://flipper.diff.org/app../items/5242>

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Headaches are a common ailment seen in pregnancy, with migraines without aura responsible for 64% of headaches in pregnancy, and migraine with aura for another 10% [7, 8]. Studies indicate that women who suffer from pre-conception migraines tend to show improvement in migraine frequency and intensity over the course of their pregnancy [3, 4, 9, 10]. However, many women continue to experience migraines in the early months of their pregnancy, and some do not obtain adequate pain relief during the second and third trimesters. There are a few reports of women even having worsening of migraines[11]. Also, de novo migraines can develop during pregnancy, often presenting as migraines with aura[12]. The incidence of gestational migraines is notable for correlations with hypertensive disease, preeclampsia, vascular complications and low birth weight infants [6,13, 14]. One could theorize that by treating gestational migraines, these other potential high-risk associations may be modulated. Treatment of gestational migraines poses a challenge because the majority of pharmacologic therapies used to