

73rd MORSS CD Cover Page

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712CD

For office use only 41205

21-23 June 2005, at US Military Academy, West Point, NY

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Original title on 712 A/B: **Wounding Patterns of United States Marines and Sailors During Operation Iraqi Freedom: Major Combat Phase**

Revised title: _____

Presented in (input and Bold one): (**WG-23**, CG____, Special Session ____, Poster, Demo, or Tutorial):

This presentation is believed to be:
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Report Documentation Page

*Form Approved
OMB No. 0704-0188*

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| | | | |
|---|------------------------------------|--|----------------------------------|
| 1. REPORT DATE 22 JUN 2005 | 2. REPORT TYPE N/A | 3. DATES COVERED - | |
| 4. TITLE AND SUBTITLE Wounding Patterns of United States Marines and Sailors During Operation Iraqi Freedom: Major Combat Phase | | 5a. CONTRACT NUMBER | |
| | | 5b. GRANT NUMBER | |
| | | 5c. PROGRAM ELEMENT NUMBER | |
| 6. AUTHOR(S) | | 5d. PROJECT NUMBER | |
| | | 5e. TASK NUMBER | |
| | | 5f. WORK UNIT NUMBER | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Health Research Center PO Box 85122 San Diego, CA 92186-5122 | | 8. PERFORMING ORGANIZATION REPORT NUMBER | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | | 10. SPONSOR/MONITOR'S ACRONYM(S) | |
| | | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) | |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited | | | |
| 13. SUPPLEMENTARY NOTES See also ADM201946, Military Operations Research Society Symposium (73rd) Held in West Point, NY on 21-23 June 2005. , The original document contains color images. | | | |
| 14. ABSTRACT | | | |
| 15. SUBJECT TERMS | | | |
| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT |
| a. REPORT unclassified | b. ABSTRACT unclassified | c. THIS PAGE unclassified | UU |
| | | | 18. NUMBER OF PAGES 24 |
| | | | 19a. NAME OF RESPONSIBLE PERSON |



Wounding Patterns of United States Marines and Sailors During Operation Iraqi Freedom: Major Combat Phase

James Zouris

**Naval Health Research Center
San Diego, California**

**Work sponsored by the Office of Naval Research, Bureau of Medicine and
Surgery, and the Marine Corps Warfighting Laboratory**

Objective

- ❑ Discuss the wounding data from OIF:
Evacuation Routes
ICD-9 Diagnostic Categories
Anatomical Locations
Causative Agent
- ❑ Methodology to generate Patient Streams in terms of Patient Condition codes

Methods

- ❑ 279 Navy–Marine Corps casualties were identified as wounded-in-action during the first phase and peak involvement of Marines during OIF (March – May 2003)
- ❑ All casualties who were seen at a level 2 medical treatment facility and who were involved in hostile actions or characterized as WIA were identified for analyses (RTD excluded).

Data were obtained from the Navy–Marine Corps CTR (n=279)

- Shock Trauma Platoons/FRSS
- Surgical companies
- Fleet Hospitals
- Landstuhl Regional Medical Center (LRMC)
- Transportation Command Regulating and Command and Control Evacuation System (TRAC2ES)
- Personnel Casualty Reports

| STP/FRSS | A-SURG | B-SURG | C-SURG | FH-3 | FH-8 | LRMC | LRMC Rec | BETHESDA | PCR | TRAC2ES |
|----------|--------|--------|--------|------|------|------|----------|----------|-----|---------|
| 83 | 54 | 124 | 48 | 59 | 80 | 147 | 96 | 123 | 252 | 260 |
| 30% | 19% | 44% | 17% | 21% | 29% | 53% | 34% | 44% | 90% | 93% |

Patient Flow Frequency Matrix

| RT | LEVEL 2- | LEVEL 2 | LEVEL 2 | LEVEL 2 | LEVEL 3 | LEVEL 3 | LEVEL 4 | LEVEL 4 | CONUS | PATIENTS | Percentage |
|----|----------|---------|---------|---------|---------|---------|---------|---------|-------|----------|------------|
| 1 | STP/FRSS | | B-SURG | | 47TH | | | LRMC | | 11 | 3.9% |
| 2 | | A-SURG | | | | | | LRMC | BETH | 10 | 3.6% |
| 3 | | | | C-SURG | 47TH | | | LRMC | BETH | 10 | 3.6% |
| 4 | | | B-SURG | | 47TH | | | LRMC | | 9 | 3.2% |
| 5 | | | B-SURG | | 47TH | | | LRMC | BETH | 9 | 3.2% |
| 6 | | | B-SURG | | | | | | | 8 | 2.9% |
| 7 | STP/FRSS | | B-SURG | | 47TH | | FH-8 | | | 8 | 2.9% |
| 8 | | | B-SURG | | 47TH | FH-3 | | LRMC | BETH | 8 | 2.9% |
| 9 | | A-SURG | | | | | | LRMC | | 6 | 2.2% |
| 10 | | | B-SURG | | 47TH | | FH-8 | | | 6 | 2.2% |
| 11 | | A-SURG | | | 47TH | | | LRMC | BETH | 6 | 2.2% |
| 12 | STP/FRSS | | B-SURG | | | | | LRMC | | 5 | 1.8% |
| 13 | | | | | 47TH | | | | | 5 | 1.8% |
| 14 | | | B-SURG | | | FH-3 | | | | 5 | 1.8% |
| 15 | | | | | | | FH-8 | | | 5 | 1.8% |
| 16 | STP/FRSS | | B-SURG | | 47TH | | | LRMC | BETH | 5 | 1.8% |
| 17 | | | | | 47TH | | FH-8 | | BETH | 5 | 1.8% |
| 18 | | | B-SURG | | | FH-3 | FH-8 | | BETH | 5 | 1.8% |

Represents approximately 50% of all Patients Evacuation Routes

ICD-9 Percentage Distribution - All Diagnoses

| ICD-9 DIAGNOSTIC CATEGORIES | <i>N</i> | % |
|--|------------|--------------|
| Open wounds (870-897), excludes amputations | 259 | 42.0 |
| Fractures (800-829) | 109 | 17.7 |
| All other ICD-9 codes | 64 | 10.4 |
| Supplemental classifications (V-codes) | 28 | 4.5 |
| Burns (940-949) | 22 | 3.6 |
| Sprains and strains (840-848) | 20 | 3.2 |
| Amputations (885-887) & (895-897) | 15 | 2.4 |
| Contusions (920-924) | 15 | 2.4 |
| Acute posthemorrhagic anemia (285.1) | 14 | 2.3 |
| Infections bacterial infection (041.XX) | 12 | 1.9 |
| Superficial injuries (910-919) | 12 | 1.9 |
| Intracranial injury (850-854) | 10 | 1.6 |
| Hearing loss (389.1) | 9 | 1.5 |
| Nerve injuries (950-957) | 9 | 1.5 |
| Dislocations (830-839) | 8 | 1.3 |
| Blindness, visual disturbances (368-369) | 7 | 1.0 |
| Crushing injury (925-929) | 6 | 0.8 |
| Total diagnoses | 617 | 100.0 |
| Total patients | 279 | |
| Average diagnosis per patient | 2.2 | |

Anatomical Location Distribution - All Regions

| ANATOMICAL LOCATIONS | |
|-----------------------------|------|
| Lower extremities | 34.5 |
| Upper extremities | 33.9 |
| Face | 5.6 |
| Chest | 5.0 |
| Back | 4.5 |
| Eye | 4.5 |
| Head | 3.9 |
| Ear | 2.7 |
| Neck | 1.9 |
| Pelvis | 1.9 |
| Abdomen | 1.7 |
| Total | 100 |
| | |
| Total anatomical areas | 454 |
| Average per patient | 1.6 |

Causative Agent Distribution

| CAUSATIVE AGENT | N | % |
|-------------------------------------|------------|------------|
| Explosive munitions | 130 | 46% |
| Shrapnel, unspecified | 40 | 14% |
| RPG | 39 | 14% |
| IED/Blasts | 20 | 7% |
| Mortar | 20 | 7% |
| Land mine | 11 | 4% |
| Small arms | 70 | 25% |
| Motor vehicle accidents | 26 | 9% |
| Falls | 18 | 6% |
| Weaponry accidents (hostile) | 10 | 4% |
| Other | 14 | 5% |
| Not stated | 11 | 4% |
| Total | 279 | |

Comparison of the Anatomical Locations by Agent

| Location | IED/Blast | Land Mine | RPG | Mortar | Shrapnel | Small Arms | All Injuries |
|-----------------------------|-----------|-----------|-------|--------|----------|------------|--------------|
| Abdomen | 0.0% | 3.0% | 1.2% | 3.3% | 0.0% | 4.9% | 1.7% |
| Back | 0.0% | 0.0% | 2.5% | 3.3% | 1.7% | 1.2% | 4.5% |
| Chest | 2.8% | 3.0% | 3.7% | 0.0% | 5.2% | 8.5% | 5.0% |
| Ear | 5.6% | 0.0% | 9.9% | 0.0% | 1.7% | 0% | 2.7% |
| Eye | 8.3% | 0.0% | 9.9% | 3.3% | 5.2% | 1.2% | 4.5% |
| Face | 13.9% | 3.0% | 2.5% | 10.0% | 15.5% | 4.9% | 5.6% |
| Neck | 0.0% | 0.0% | 2.5% | 0.0% | 6.9% | 1.2% | 1.9% |
| Head | 5.6% | 0.0% | 6.2% | 3.3% | 5.2% | 1.2% | 3.9% |
| Lower extremities | 30.6% | 78.8% | 25.9% | 33.3% | 29.3% | 31.7% | 34.5% |
| Pelvis | 2.8% | 0.0% | 2.5% | 6.7% | 1.7% | 2.4% | 1.9% |
| Upper extremities | 30.6% | 12.1% | 33.3% | 36.7% | 27.6% | 42.7% | 33.9% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Patients | 20 | 11 | 39 | 20 | 40 | 70 | 279 |
| Anatomical regions | 39 | 33 | 81 | 30 | 58 | 82 | 454 |
| Average regions per patient | 2.0 | 3.0 | 2.1 | 1.5 | 1.5 | 1.1 | 1.6 |

| ICD-9 Categories | IED/ Blasts | Landmine | RPG | Mortar | Shrapnel | Small Arms | |
|---|----------------|----------|-------|--------|----------|---------------|-------|
| Acute post hemorrhagic anemia (285.1) | 3.2% | 6.8% | 4.0% | 0.0% | 0.0% | 2% | 2.3% |
| Blindness Visual Disturbances (360-379) | 0.0% | 0.0% | 5.0% | 0.0% | 2.9% | 0% | 1.0% |
| Hearing Loss (389.1) | 1.6% | 0.0% | 6.0% | 1.6% | 1.5% | 0% | 1.5% |
| Fractures (800-829) | 11.3% | 13.6% | 12.0% | 6.5% | 5.9% | 17% | 17.7% |
| Dislocations (830-839) | 1.6% | 0.0% | 0.0% | 0.0% | 0.0% | 0% | 1.3% |
| Sprains and Strains (840-848) | 0.0% | 0.0% | 2.0% | 1.6% | 0.0% | 1% | 3.2% |
| Intracranial Injury (850-854) | 3.2% | 0.0% | 2.0% | 1.6% | 0.0% | 1% | 1.6% |
| Open Wounds (870-897) | 53.2% | 43.2% | 36.0% | 37.1% | 72.1% | 52% | 42.0% |
| Amputations (885-887) & (895-897) | 3.2% | 13.6% | 6.0% | 3.2% | 0.0% | 0% | 2.4% |
| Superficial Injuries (910-919) | 4.8% | 2.3% | 3.0% | 0.0% | 1.5% | 0% | 1.9% |
| Contusions (920-924) | 3.2% | 0.0% | 2.0% | 1.6% | 4.4% | 0% | 2.4% |
| Crushing Injury (925-929) | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0% | 0.8% |
| Burns (940-949) | 3.2% | 0.0% | 8.0% | 8.1% | 0.0% | 0% | 3.6% |
| Nerve injuries (950-957) | 0.0% | 2.3% | 1.0% | 0.0% | 1.5% | 4% | 1.5% |
| All Other ICD-9 Codes | 6.5% | 13.6% | 4.0% | 9.7% | 10.3% | 11% | 10.4% |
| Supplemental classifications (V-codes) | 4.8% | 4.5% | 5.0% | 0.0% | 0.0% | 9% | 4.5% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | |
| Patients | 20 | 11 | 39 | 20 | 40 | 70 | 279 |
| Total number of ICD-9 codes | 62 | 44 | 100 | 44 | 68 | 155 | 617 |
| Average No. of ICD-9 per patient | 3.1 | 4.0 | 2.6 | 2.2 | 1.7 | 2.2 | 2.2 |

Results and Findings

- THE DISTRIBUTION OF BATTLE INJURIES AND ANATOMICAL LOCATIONS DIFFER BY CAUSATIVE AGENT
- APPROXIMATELY 2 OUT OF 3 BATTLE INJURIES ARE OPEN WOUNDS AND OR FRACTURES
- APPROXIMATELY 3 OUT OF 4 INJURIES ARE TO THE EXTREMITIES
- CASUALTIES ARE SUSTAINING MULTIPLE INJURIES PRIMARILY DUE TO EXPLOSIVE MUNITIONS
 - 2.2 ~ *ICD-9 DIAGNOSES PER PATIENT*
 - 1.6 ~ *AFFECTED ANATOMICAL LOCATIONS*

Approach to update the Planning Factors

- (1) Update the default PC code percentages for the Navy/Marines that are currently incorporated into MAT to reflect the recent injury and illness patterns from OIF
- (2) Update and develop a standardized methodology to determine admission and occurrence rates for Navy and Marine Corps DNBI rates.

MAT provides medical planners worldwide the level and scope of medical support needed for a joint operation, and the capability of evaluating courses of action for probable scenarios.

MAT is part of the TMIP which provides automated solutions for deployed forces during all military operations.

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---------------------------|---------------|---------------|---------------|-----------------|----------------|----------------|---------------|---------------|---------------|---|
| | radius/ulna | 13.9% | 13.9% | 13.9% | 2.0% | 13.9% | 13.9% | 13.9% | 13.9% | 13.9% | |
| | rib | 1.7% | 1.7% | 1.7% | 0.7% | 1.7% | 1.7% | 1.7% | 1.7% | 1.7% | |
| | spine | 2.3% | 2.3% | 2.3% | 0.3% | 2.3% | 2.3% | 2.3% | 2.3% | 2.3% | |
| | tibia/fibula | 19.0% | 19.0% | 19.0% | 25.0% | 19.0% | 19.0% | 19.0% | 19.0% | 19.0% | |
| | MUST EQUAL 100 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |
| | CLOSED FRACTURES | MAT | bombs | shells | landmine | grenade | gunfire | mortar | IED | Blunt | |
| | facial excluding mandible | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | |
| | femur | 6.0% | 6.0% | 6.0% | 6.0% | 6.0% | 6.0% | 6.0% | 6.0% | 6.0% | |
| | foot/ankle | 13.6% | 13.6% | 13.6% | 13.6% | 13.6% | 13.6% | 13.6% | 13.6% | 13.6% | |
| | hand/finger | 10.5% | 10.5% | 10.5% | 10.5% | 10.5% | 10.5% | 10.5% | 10.5% | 10.5% | |
| | skull | 4.3% | 4.3% | 4.3% | 4.3% | 4.3% | 4.3% | 4.3% | 4.3% | 4.3% | |
| | humerus | 4.4% | 4.4% | 4.4% | 4.4% | 4.4% | 4.4% | 4.4% | 4.4% | 4.4% | |
| | mandible | 3.3% | 3.3% | 3.3% | 3.3% | 3.3% | 3.3% | 3.3% | 3.3% | 3.3% | |
| | knee | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | |
| | pelvis | 2.7% | 2.7% | 2.7% | 2.7% | 2.7% | 2.7% | 2.7% | 2.7% | 2.7% | |
| | radius/ulna | 9.2% | 9.2% | 9.2% | 9.2% | 9.2% | 9.2% | 9.2% | 9.2% | 9.2% | |
| | rib | 4.5% | 4.5% | 4.5% | 4.5% | 4.5% | 4.5% | 4.5% | 4.5% | 4.5% | |
| | clavicle | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | 3.6% | |
| | spine | 10.3% | 10.3% | 10.3% | 10.3% | 10.3% | 10.3% | 10.3% | 10.3% | 10.3% | |
| | tibia/fibula | 22.7% | 22.7% | 22.7% | 22.7% | 22.7% | 22.7% | 22.7% | 22.7% | 22.7% | |
| | MUST EQUAL 100 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |
| | OPEN WOUNDS | MAT | bombs | shells | landmine | grenade | gunfire | mortar | IED | Blunt | |
| | abdomen | 3.0% | 3.0% | 3.0% | 3.0% | 1.1% | 3.0% | 3.0% | 3.0% | 3.0% | |
| | IntraAbdominal (crush) | 0.7% | 0.7% | 0.7% | 0.3% | 0.7% | 0.7% | 0.7% | 0.7% | 0.7% | |
| | forearm/upper arm | 18.3% | 18.3% | 18.3% | 18.3% | 20.2% | 18.3% | 18.3% | 18.3% | 18.3% | |
| | Shrapnel (multiple) | 5.1% | 5.1% | 5.1% | 5.1% | 5.1% | 5.1% | 5.1% | 5.1% | 5.1% | |
| | buttocks | 3.9% | 3.9% | 3.9% | 3.9% | 3.9% | 3.9% | 3.9% | 3.9% | 3.9% | |
| | eye | 2.2% | 2.2% | 2.2% | 2.2% | 2.2% | 2.2% | 2.2% | 2.2% | 2.2% | |
| | face/neck | 11.8% | 11.8% | 11.8% | 3.0% | 11.8% | 11.8% | 11.8% | 11.8% | 11.8% | |
| | foot/ankle/toe | 5.3% | 5.3% | 5.3% | 25.0% | 5.3% | 5.3% | 5.3% | 5.3% | 5.3% | |
| | genitals | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | |
| | hand/finger | 5.3% | 5.3% | 5.3% | 5.3% | 5.3% | 5.3% | 5.3% | 5.3% | 5.3% | |
| | head | 5.6% | 5.6% | 5.6% | 1.0% | 5.6% | 5.6% | 5.6% | 5.6% | 5.6% | |
| | leg | 29.8% | 29.8% | 29.8% | 30.4% | 29.8% | 29.8% | 29.8% | 29.8% | 29.8% | |
| | shoulder | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | |
| | thorax | 6.5% | 6.5% | 6.5% | 0.0% | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% | |
| | Pneumohemothorax | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | MUST EQUAL 100 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |
| | MULTIPLE WOUNDS | MAT | bombs | shells | landmine | grenade | gunfire | mortar | IED | Blunt | |

Transportation Command (TRANSCOM) Regulating and Command and Control Evacuation System (TRAC2ES) and Personnel Casualty Reports were used to validate and verify information. TRAC2ES provides transportation planners documentation on patient regulation/movement in the theater of operations.

| | Air Force | Army | Marine Corps | Navy |
|--------------------------|------------------|---------------|---------------------|---------------|
| OEF-Battle Injury | 1.0% | 0.6% | 1.3% | 1.1% |
| OEF-DNBI | 40.2% | 8.6% | 11.9% | 32.1% |
| OIF-Battle Injury | 1.9% | 11.3% | 29.5% | 2.8% |
| OIF-DNBI | 56.9% | 79.5% | 57.2% | 64.1% |
| | 100.0% | 100.0% | 100.0% | 100.0% |
| | | | | |
| N-size* | 895 | 13313 | 2282 | 757 |

***Multiple Patient Movement**

Source TRAC2ES Jan03 – Aug03

METHODS

- **All casualties who were involved in hostile actions or characterized as Battle Injury were identified for analyses**
- **10% of records had conflicting information on type of casualty event whether it was Hostile or Non Hostile**
- **When a patient had conflicting information on the casualty event the incident report was used to make judgment call**
- **Only Primary Diagnosis Information was used for analysis**
- **The last MTF was used as the primary diagnoses if differed from previous MTF (exception V-code)**
- **Three methods of Identifying the casualty were used to determine each unique patient: SSN, NAME, Patient ID**

TRAC2ES

672 Total Patient Movement to Different MTF for 265 Marines = 2.53

1499 Total Patient Movement to Different MTF for 594 Soldiers = 2.52

CHI Square Comparison of Primary ICD-9 Diagnostic Categories by Army and Marines Battle Casualties

| | Army (n=594) | Marines (n=266) |
|---------------------------|--------------|------------------------------|
| Amputations | 3.9% | 3.8% |
| Burns | 4.9% | 3.0% |
| Crushing | 1.7% | 1.5% |
| Dislocation | 1.2% | 1.9% |
| E-code | 2.5% | 1.1% |
| Fractures | 20.2% | 21.1% |
| Intracranial | 0.8% | 2.3% |
| Missing | 2.2% | 1.9% |
| Musculoskeletal | 3.5% | 2.6% |
| Other | 3.4% | 1.1% |
| Other Injuries | 2.7% | 1.5% |
| Sense-ear | 5.9% | 2.3% |
| Sense-eye | 2.5% | 0.8% |
| Sprain | 3.0% | 3.4% |
| Wound | 41.6% | 51.9% |
| Value = 24.39 | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 14 | p=0.041 |

CHI Square Comparison of Anatomical Location of Primary Open Wound for Army and Marines Battle Casualties

| | Army (n=247) | Marines (n=138) |
|---------------------------|--------------|------------------------------|
| Abdomen | 5.7% | 2.9% |
| Buttock | 3.2% | 3.6% |
| Eye/Ear | 8.1% | 2.9% |
| Face/Neck | 8.5% | 10.9% |
| Foot/ankle | 5.7% | 7.2% |
| Arm | 11.7% | 18.1% |
| Hand/wrist | 5.7% | 5.1% |
| Head | 2.8% | 2.2% |
| Leg | 27.5% | 29.7% |
| Multiple | 5.7% | 1.4% |
| Shoulder | 3.6% | 6.5% |
| Thorax | 11.7% | 9.4% |
| Value = 14.93 | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 11 | p=0.19 |
| N of Valid Cases | 385 | |

CHI Square Comparison of Anatomical Location of Fracture for Army and Marines Battle Casualties

| | Army (n=120) | Marines (n=56) |
|---------------------------|--------------|------------------------------|
| Femur | 10.8% | 10.7% |
| Foot/Ankle/Toes | 24.2% | 12.5% |
| Hand/Wrist/Fingers | 12.5% | 19.6% |
| Humerus | 5.8% | 3.6% |
| Mandible | 3.3% | 7.1% |
| Other | 11.7% | 7.1% |
| Radius | 5.8% | 8.9% |
| Spine | 4.2% | 8.9% |
| Tibia | 21.7% | 21.4% |
| Value = 8.29 | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 8 | p=0.41 |
| N of Valid Cases | 176 | |

PCOF ESTIMATOR

SUMMARY

- THE DISTRIBUTION OF BATTLE INJURIES WERE DEPENDENT OR VARIED FOR MARINES AND ARMY SOLDIERS DURING OIF-1
- THE LOCATION OF OPEN WOUNDS DID NOT VARY FOR MARINES AND SOLDIERS
- THE LOCATION OF FRACTURES DID NOT VARY FOR MARINES AND SOLDIERS

| OPEN WOUNDS | MAT | OIF-1 | |
|---------------------|------------|--------------|--|
| Abdomen | 3.7% | 4.7% | |
| Forearm/upper arm | 18.3% | 14.0% | |
| Shrapnel (multiple) | 5.1% | 4.2% | |
| Buttocks | 3.9% | 3.4% | |
| Eye | 2.2% | 6.2% | |
| Face/neck | 11.8% | 9.4% | |
| Foot/ankle/toe | 5.3% | 6.2% | |
| Genitals | 0.5% | | |
| Hand/finger | 5.3% | 5.5% | |
| Head | 5.6% | 2.6% | |
| Leg | 29.8% | 28.3% | |
| Shoulder | 2.0% | 4.7% | |
| Thorax | 6.5% | 10.9% | |

| FRACTURES | MAT | | OIF-1 |
|---------------------------|------------|--|--------------|
| Clavicle | 0.5% | | 2.3% |
| Facial excluding mandible | 3.8% | | 2.3% |
| Femur | 12.1% | | 10.8% |
| Foot/ankle | 11.6% | | 20.5% |
| Hand/finger | 12.7% | | 14.8% |
| Skull | 3.1% | | 2.3% |
| Humerus | 12.4% | | 5.1% |
| Mandible | 2.5% | | 4.5% |
| Knee | 1.2% | | 1.1% |
| Pelvis | 2.0% | | 1.1% |
| Radius/ulna | 13.3% | | 6.8% |
| Rib | 2.1% | | 1.1% |
| Spine | 3.3% | | 5.7% |
| Tibia/fibula | 19.5% | | 21.6% |