Orthopaedic Field Experience at a Level II Navy Surgical Facility during Operation Iraqi Freedom

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ABSTRACT

A review of the orthopaedic surgical experience at a level II Navy field hospital during Operation Iraqi Freedom was undertaken. A retrospective data review was performed to evaluate include demographics of casualties treated; mechanism of injury; and procedures performed.

Results confirm that a majority of the injuries sustained on the battlefield will be to the musculoskeletal system. Both battle and non-battle injuries were administered to. The surgical environment remains austere at the level of the echelon II field hospital, requiring tolerance and improvisation. Management of the wounds remains unchanged, i.e. debridement and stabilization, and may be referred to in present day terms as damage control orthopaedics. Our results differ from the etiology of the injuries seen from other reports of recent campaigns. The majority of the battle injuries attended to at this facility were due to missile wounds as opposed to blast injuries as seen in other recent campaigns. Despite this the majority of wounds remained orthopaedic. The Orthopaedic surgeon is a vital asset to our fighting force in the field.

1.0 OBJECTIVES

Review of the field orthopaedic surgical experience at a Navy level II facility assigned to the US Marine Corps during Operation Iraqi Freedom.

1.1 METHODS

A retrospective review was performed of the orthopaedic procedures performed at Bravo Surgical Company covering the period of 3 April 2003 to 4 May 2003 (28 operational days). Data was retrieved from operating room and personal logs. The data reviewed included all surgical cases performed in the Bravo Surgical Co.

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OR and the orthopaedic procedures performed at Forward Resuscitative Surgical System 5 (FRSS 5) while it was co-located with Bravo Surgical Co (while the FRSS and Surgical Company were co-located all patients were staged through the Surgical Company's resuscitation area, but varied as to which operating room they were taken to).

The data was reviewed to evaluate: (1) casualties attended to by an orthopaedic surgeon; (2) make-up of casualties i.e. Iraqi vs. U.S. Forces; (3) procedures performed; (4) cause of injury i.e. battlefield or non-battle injuries. Only those patients with which direct contact was made and who subsequently received intervention by the orthopaedic surgeon are presented. Patients managed via verbal consultation with non-orthopaedic colleagues are not presented.

The environment was a Navy level II surgical facility (i.e. field hospital) in support of the US Marine Corps during Operation Iraqi Freedom. Tents were used for resuscitations areas, operating rooms (Fig. 1a), and holding wards. The floors were the desert sand and included unexpected visitors (Figs. 1b and 1c). The mission was for the Surgical Company to be in position so that life and limb saving procedures could be performed prior to the patients being transported to more definitive care. Equipment available included digital x-rays, military individually packed external fixation devices (Fig. 2), dressing material, and rudimentary surgical equipment (transportability being the limiting factor). The Surgical Company has a 72-hour holding capacity by doctrine and as such all attempts were made to transfer patients to higher levels of care within that constraint.

1.1.1 RESULTS

Bravo Surgical Co. had 66 casualties treated in the operating room. 41/66 (62%) of these casualties were attended to by an orthopaedic surgeon (Fig. 3), a general surgeon attended to the remaining casualties. Staffing of Bravo Surgical Co included 2 general surgeons, 3 ob/gyns, and 1 orthopaedic surgeon. Staffing of FRSS 5 included 1 general surgeon and 1 orthopaedic surgeon.

An orthopaedic surgeon treated a total of 53 casualties from 3 April 2003 to 4 May 2003 (Table 1); on 3 April and from 8 April to 13 April Bravo Surgical Company and FRSS 5 were co-located and both authors attended to procedures performed on those days. 27/53 (51%) of the patients and 41 % of the procedures reviewed were attended to by both authors (AT and CE), the remaining casualties reviewed were attended to by AT.

41 casualties were treated in the Bravo Surgical Co. OR, 7 casualties in the FRSS 5 OR, and 5 casualties were treated at Bravo Surgical Co outside the formal operating room (Fig. 4). 26/53 (49%) of the casualties treated were Iraqi; 27/53 (51%) were U.S. Forces (Fig. 5). 39/53 (74%) of the casualties sustained battlefield injuries: 27 from missile wounds, and 12 from blast injuries (Fig. 7). 14/53 (26%) of the casualties sustained non-battle injuries: 6 MVA/MCA, and 8 occupational or recreational injuries (Fig. 8). No patient was operated on more than once, as all casualties (Iraqi and US), were transferred to higher echelon of care within 48 hours.

124 total procedures were performed on the 53 casualties. The procedures included: fasciotomy /compartment release (61); I & D and stabilization of open wounds / fractures (24); amputations (15); ex-fix (9); arthrotomy (6); closed reduction and stabilization (6); radial artery repair (1); sagittal band repair (1); removal of hardware (1) (Fig. 9). All wounds were left open and dressed with a wet to dry dressing. 79/124 (63%) procedures on 35/53 (66%) of the casualties were performed in the first 11 days (9 operational days). Further delineation, by body region, of fasciotomies / compartment releases, amputations, and external fixators can be seen in Figs. 10, 11, and 12 respectively.

External fixators were limited in supply and were used most often to manage unstable injuries that were not otherwise amenable to splinting (Figs. 12a and 12b). Severity of wounds and their management are represented in Figs. 13a through 15c.

With some severe wounds improvisation was necessary for optimal management (Figs. 15a, 15b and 15c). In this case dental acrylic was used, as it was incidentally discovered that the material used by our dental colleagues for capping teeth was similar in character to PMMA used in orthopaedic practice.

1.1.1.1 CONCLUSIONS

Shortfalls in this review include lack of follow-up as all pts were transferred from our facility in short order and received further care at the next echelon of care. Another deficiency is that data on all orthopaedic injuries that were treated at the Surgical Company are not presented, as many of the non-operative orthopaedic injuries were treated by non-orthopaedic colleagues, i.e. FP's, Dentists, and PA's via verbal consultation since the tempo of operations was too great to allow for direct intervention by the surgeon.

A consequence of any military campaign will be taking of casualties. Recent campaigns have shown that 60-70% of battlefield injuries will be to the musculoskeletal system[1-5]. The majority of penetrating injuries sustained in recent wars are reported to have been the result of blast injuries. [1,3,6] Our experience does confirm that the majority of injuries sustained on the battlefield are to the musculoskeletal system. The cause, however, of the majority of wounds was a result of missile rather than blast injuries as seen previously. This was probably due to the way this campaign was waged, with an early and heavy ground assault. The orthopaedic surgeon is an essential and vital asset in the field setting. The majority of the surgical expertise that will be needed in the field for future campaigns will be from an orthopaedist.

The type of surgery performed could be called damage control orthopaedics, in keeping with the principles used to manage femur fractures with temporary external fixators prior to definitive osteosynthesis in the multiply injured civilian trauma patient.[7-11] The same principles are applied in the field (i.e. temporary stabilization with delayed definitive fracture fixation). The limiting factor in the field not only being the severity of the injuries, but also of the environment in which the treatment is rendered. The flow of casualties, as expected, followed the pace of the battles being waged and our experience showed the high intensity of the battles being waged in a short duration of time. Despite advances in our specialty, modern day field orthopaedics remains a practice in an extremely austere environment with only rudimentary and limited equipment requires adherence to the principles of battlefield wound management[2, 12] and necessitates tolerance, improvisation and innovation on the part of the surgeon.

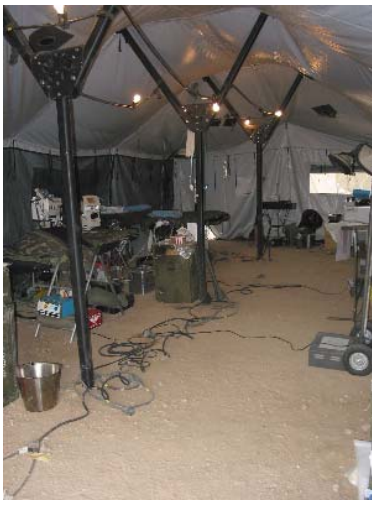

Fig. 1a Operating Room

Fig. 1b Operating Room

Fig. 1c Operating Room

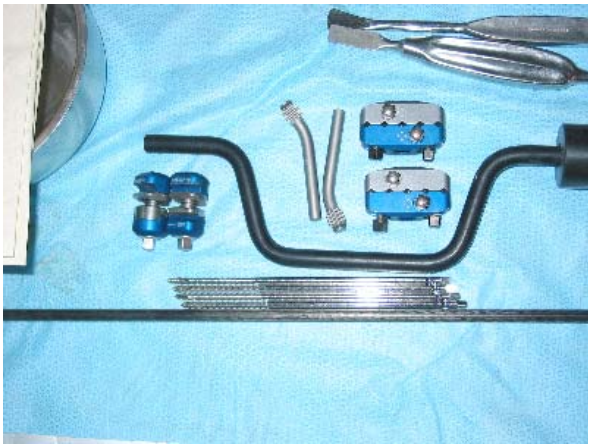

Fig. 2 **Individually packed military external fixator**

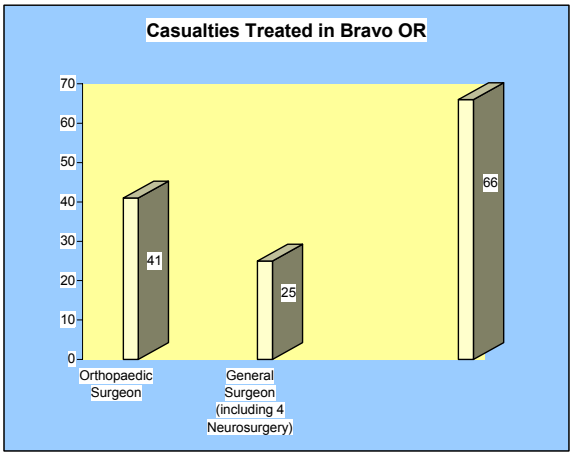

Fig. 3

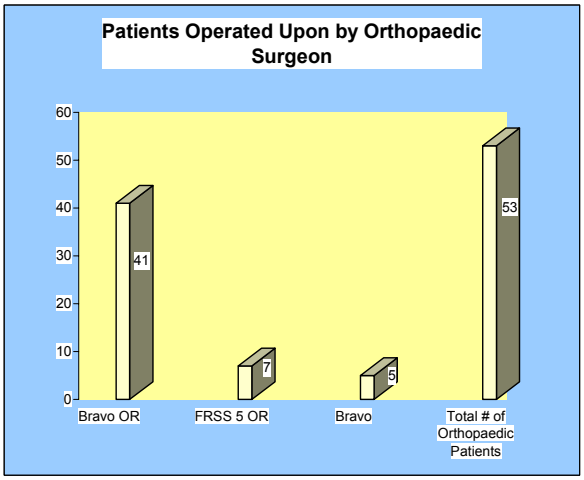

Fig. 4

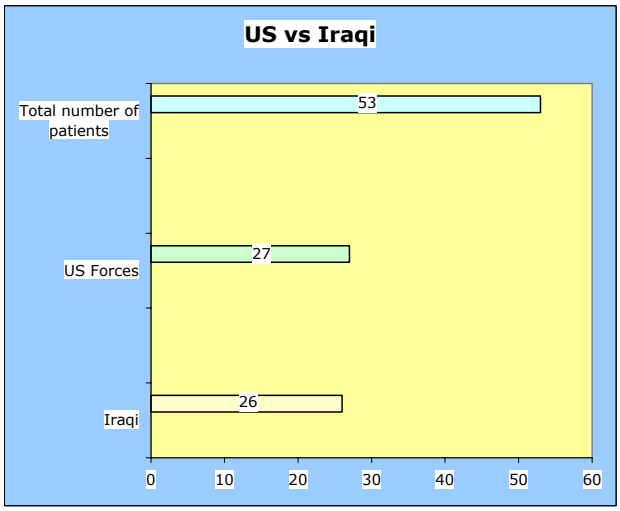

Fig. 5

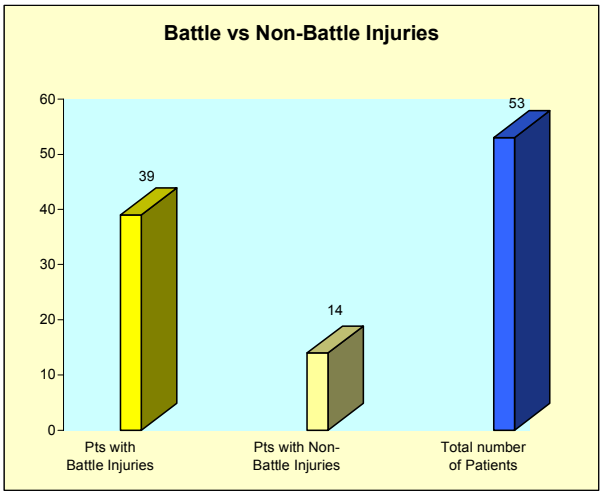

Fig. 6

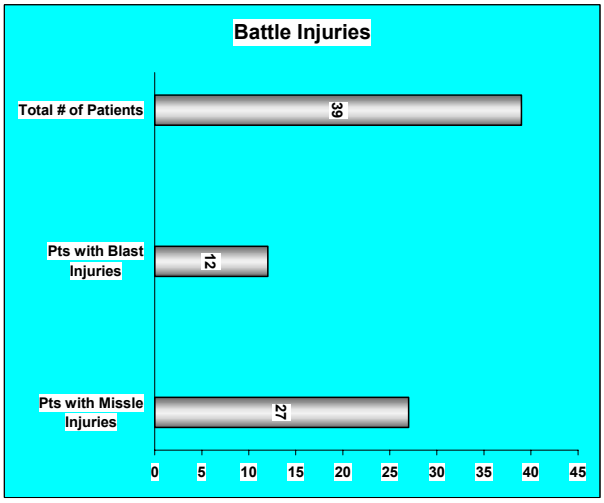

Fig. 7

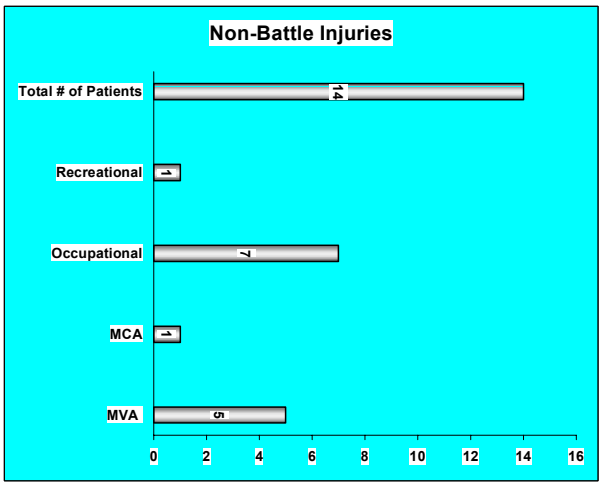

Fig. 8

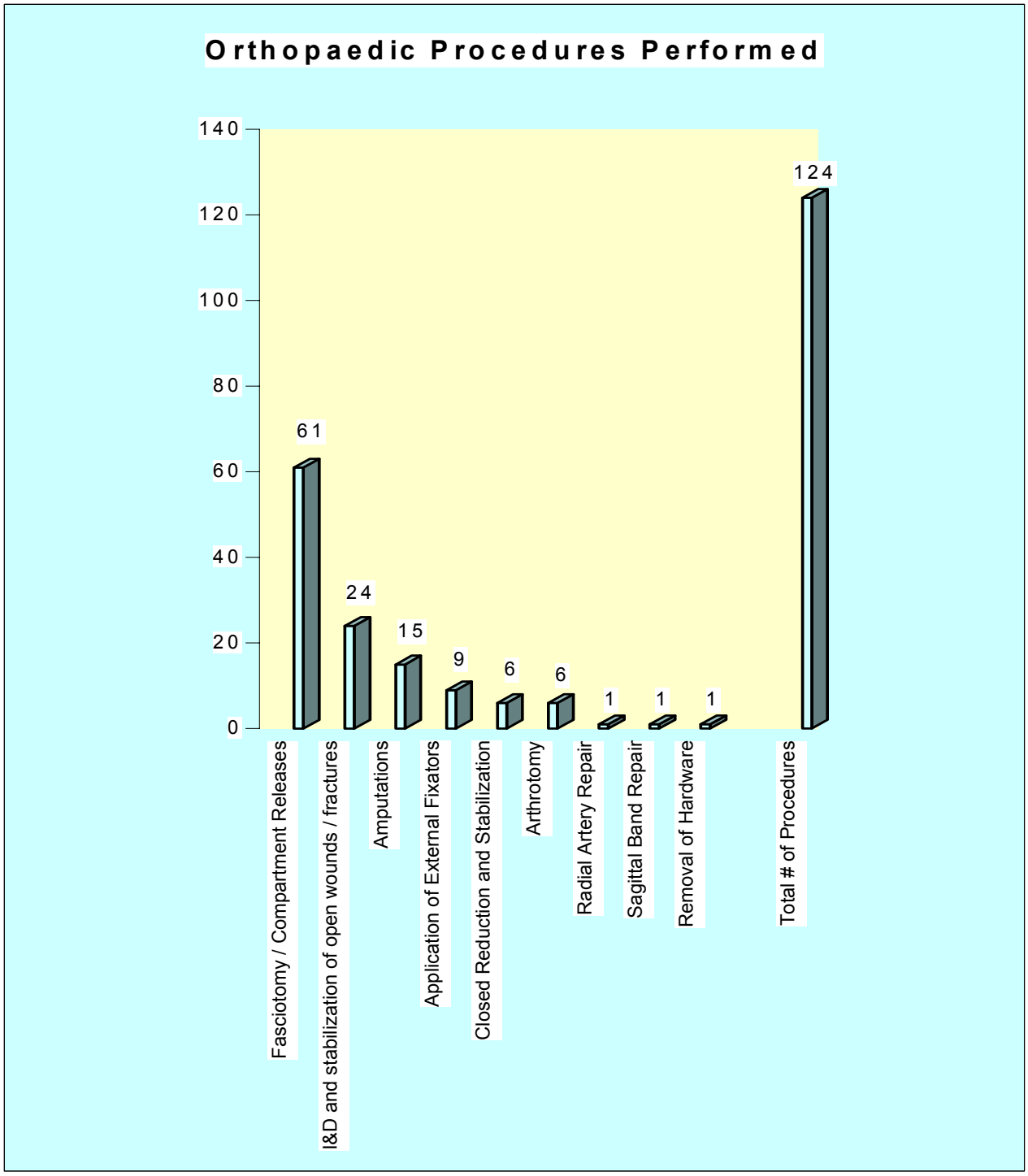
Orthopaedic Procedures Performed
140
120
100
80
60
40
20
0
61
24
15
9
6
6
1
1
1
124
Fasciotomy / Compartment Releases
I&D and stabilization of open wounds / fractures
Amputations
Application of External Fixators
Closed Reduction and Stabilization
Arthrotomy
Radial Artery Repair
Sagittal Band Repair
Removal of Hardware
Total # of Procedures

Fig. 9

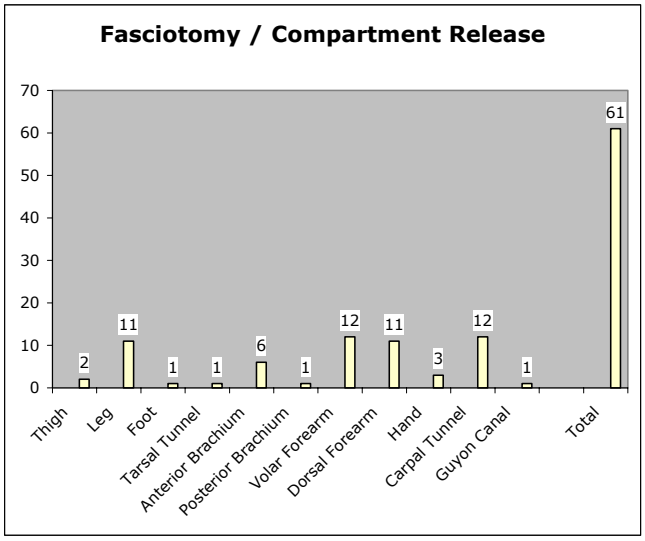
Fasciotomy / Compartment Release
70
60
50
40
30
20
10
0
2
11
1
1
6
1
12
11
3
12
1
61
Thigh
Leg
Foot
Tarsal Tunnel
Anterior Brachium
Posterior Brachium
Volar Forearm
Dorsal Forearm
Hand
Carpal Tunnel
Guyon Canal
Total

Fig. 10

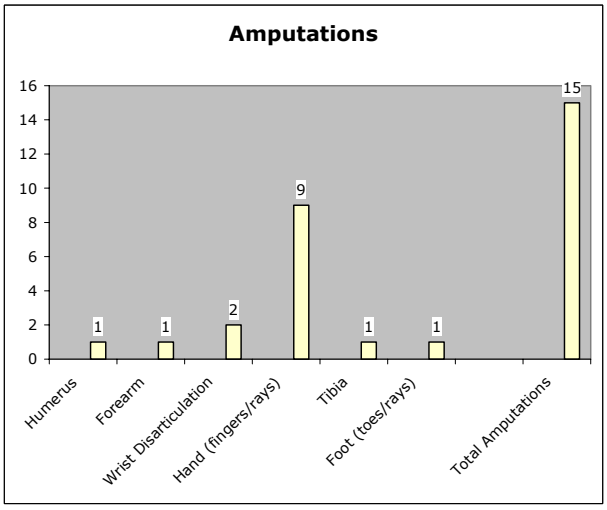
Amputations
16
14
12
10
8
6
4
2
0
1
1
2
9
1
1
15
Humerus
Forearm
Wrist Disarticulation
Hand (fingers/rays)
Tibia
Foot (toes/rays)
Total Amputations

Fig. 11

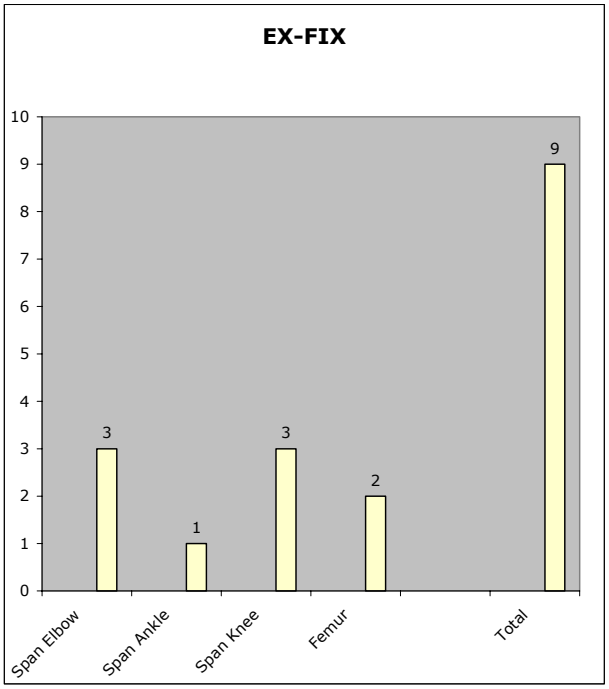

Fig. 12a

Fig. 12b fasciotomy and external fixator bridging elbow for GSW to distal humerus

Fig. 13a GSW to Hand

Fig. 13b wound debrided & wrist disarticulation performed

Fig. 14a High Energy GSW to knee with 2^0 injuries to proximal tibia from bone fragments. Wounds grossly contaminated with dirt, rocks, etc.

Fig. 14b debridement and stabilization prior to transfer completed

Fig. 15a 4x6cm segmental defect radius and ulna s/p high energy GSW

Fig. 15b placement of intercalary spacer using dental acrylic

Fig. 15c dental acrylic

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