

## Does Delayed Closure of Both Bone Forearm Fractures Increase Infection Rates?

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### INTRODUCTION

- Adult both bone forearm fractures are a common injury. Primary closure is sometimes not possible due to edema, thus delayed wound closure, including delayed primary closure, a skin graft or even a flap, is then required.
- Our study aimed to identify risk factors for delayed closure and to compare differences in complication rates between primary and delayed closure in both bone forearm fracture patients.
- Our hypothesis is that risk factors can be identified and that complications will be higher in the secondary closure group.

### METHODS

**Design:** Retrospective cohort study.

**Setting:** Single Level 1 trauma center.

**Population:** Adult patients (18+) that underwent ORIF for both bone forearm fractures from January 2007 through April 2019.

- Primary closure was attempted unless the skin was thought to be too tight as indicated by excessive skin blanching or Doppler Allen's test abnormality upon attempted closure

#### Analysis:

- Demographic and injury descriptors were compared for the primary and delayed closure group.
- Patient age, fracture severity (open vs. closed), involvement of the proximal radius or ulna, segmental fractures, mechanism of injury, ipsilateral upper extremity fractures, intra-operative neurovascular repair, and ISS were included as candidate factors for delayed wound closure
- The penalized regression was used to determine risk factors for delayed closure. Adjusted odds ratios are reported with 95% confidence interval
- Survival analysis was used to determine the rates of infection and wound complications, censoring non-event patients at their last clinical follow up. Cox proportional hazard models were used to determine the risk of infection and wound complications associated with primary versus secondary closure, controlling for open fractures. Hazard ratio are reported with primary closure as the reference value.

**Table 1:** Patient demographics

| Patient Characteristic               | Total (%) N=340 |
|--------------------------------------|-----------------|
| Age (mean, SD)                       | 41.0, 17.1      |
| Sex                                  |                 |
| Male                                 | 228 (67.1)      |
| Female                               | 112 (32.9)      |
| Type of wound closure                |                 |
| Primary                              | 270 (79.4)      |
| Delayed                              | 70 (20.6)       |
| Fracture location                    |                 |
| Proximal 1/3 <sup>rd</sup>           | 55 (16.2)       |
| Middle 1/3 <sup>rd</sup>             | 171 (50.3)      |
| Distal 1/3 <sup>rd</sup>             | 95 (27.9)       |
| Segmental                            | 19 (5.6)        |
| Open fracture                        |                 |
| Yes                                  | 148 (43.5)      |
| No                                   | 192 (56.5)      |
| Operative ipsilateral UE fracture    |                 |
| Yes                                  | 54 (15.9)       |
| No                                   | 286 (84.1)      |
| Intra-operative neurovascular repair |                 |
| Nerve                                | 5 (1.5)         |
| Artery                               | 9 (2.6)         |
| Mechanism of injury                  |                 |
| GSW                                  | 7 (2.1)         |
| MVC/MCC                              | 224 (65.9)      |
| Ped struck                           | 28 (8.2)        |
| Fall                                 | 55 (16.2)       |
| Blunt trauma                         | 11 (3.2)        |
| Industrial                           | 14 (4.1)        |
| Other                                | 1 (0.3)         |
| ISS (mean, SD)                       | 19.3, 11.7      |
| Type delayed closure                 |                 |
| Split-thickness skin graft           | 51 (72.9)       |
| Delayed primary                      | 14 (20.0)       |
| Flap                                 | 3 (4.3)         |
| Amputation                           | 2 (2.9)         |

**Table 3:** Comparison of infection and wound complication rates

| Characteristic         | Primary<br>% (95% CI) | Delayed<br>% (95% CI) | Adjusted Hazard Ratio<br>(95% CI) |
|------------------------|-----------------------|-----------------------|-----------------------------------|
| 1-year infection rate  | 2.0 (0.0-4.5)         | 13.9 (1.3-24.9)       | 2.1 (0.9-18.3, p=0.07)            |
| 1-year wound comp rate | 1.1 (0.0-2.4)         | 0                     | 1.5 (0.2-9.7, p=0.62)             |

**Table 2:** Factors associated with delayed wound closure

| Factor                       | Adjusted OR (95% CI) | P Value |
|------------------------------|----------------------|---------|
| Open Fracture                | 4.0 (2.2 – 7.1)      | <0.01   |
| Closed Fracture              | Ref (1.0)            |         |
| Fracture Location, Segmental | 1.7 (0.9 – 3.4)      | 0.10    |
| Fracture Location, Distal    | Ref (1.0)            |         |

### RESULTS

- Open fractures were identified as the primary risk factor for delayed wound closure (OR 4.0, 95% CI 2.2-7.1; p<0.01)
- Only eight patients (2%) developed a deep surgical site infection
- 7 patients presented with compartment syndrome on admission (N=2) or after fixation (N=5), with delayed closure was planned as a result.
- When censored for available follow up, the 1-year infection rate among delayed closure patients was 14% (95% CI: 1.3-24.9) compared to 2% (95% CI: 0.0-4.5) in the primary closure group (adjusted hazard ratio: 2.1, 95% CI: 0.9 – 18.3, p=0.07)
- Five patients in the primary closure patients developed postoperative wound dehiscence (1.1%, 95%: 0.0 – 2.4%). None of the secondary wound closure patients had wound complications (p=0.62).

### CONCLUSIONS

- A large percentage (21%) of both bone fractures at our center required delayed closure.
- An open fracture was the only identifiable risk factor for delayed closure in this high energy cohort.
- Wound problems were rare in both groups, but the risk of a deep infection in the delayed wound closure showed a trend towards increased infection (14% vs 2%, p=0.07) likely due to selection bias of more severe open injuries requiring delayed closure.