Does Primary Wound Closure Following Open Fracture Affect Development of Deep Infection or Nonunion? A Prospective Cohort Study of 83 Subjects with 84 Open Fractures

Angela Scharfenberger, MD*; Khaled Al-Abbasi, MD; Stephanie Smith, MD; Don Weber, MD; Sukhdeep Dulai, MD, MSc; Joseph Bergman, MD; Lauren Beaupre, PT, PhD; University of Alberta, Alberta, CANADA*

Purpose: The primary purpose was to determine the proportion of subjects developing deep infection or nonunion following primary closure of open fracture (humerus, radius/ulna, femur, tibia/fibula). Secondarily, a matched series analysis compared these outcomes with subjects who had undergone delayed closure after an open fracture in a previous cohort study. We hypothesized that primary closure would not adversely affect outcomes.

Methods: Between 2009 and 2013, 83 subjects with 84 open fractures who underwent primary wound closure at the initial surgery were enrolled prospectively at a Level I trauma center and followed for 1 year. Primary wound closure was performed when the Gustilo grade was 3A or lower and the wound was deemed clean at time of initial surgery. Demographics, injury information (eg, Gustilo grade, fracture site, injury mechanism, timing of antibiotic administration and initial surgery) were recorded. Subjects were evaluated postoperatively using standardized data forms until the fracture(s) healed. Phone interviews and chart reviews were undertaken at 1 year post fracture. These subjects were matched to a previous prospective cohort subjects with open fractures undertaken between 2001 and 2009 at the same center with similar selection criteria and study procedures. Subjects were matched on age, gender, fracture location, and Gustilo grade with blinding to outcomes at time of case matching. Nonunion was defined as unplanned surgical intervention after definitive wound closure or incomplete radiographic healing 1 year post fracture. Deep infection was defined as infection requiring unplanned surgical debridement and/or sustained antibiotic therapy following definitive wound closure. Descriptive analyses were undertaken on the primary closure cohort to examine outcomes. Matched analysis was undertaken on 68 pairs of subjects who were matched on all four variables(age, gender, fracture location, Gustilo grade). Unmatched subjects (n = 16 [19%]) were more likely to be older ($P < 0.001$) females ($P = 0.009$) with lower-grade Gustilo($P = 0.009$) upper extremity fractures ($P = 0.009$). There was no difference in union or infection outcomes between matched and unmatched subjects ($P = 1.0$).

Results: The majority (n = 52 [62%]) were male, the mean age was 47.2 ± 21.0 years, and almost half (n = 40 [49%]) had no coexisting conditions. Motor vehicle accidents were most common (n = 38 [49%]), followed by falls (n = 34 [42%]), crush injuries (n = 6 [7%]), and assaults (n = 6 [7%]). Fracture distribution was similar among upper extremity (n = 36 [43%]) and tibia/fibula (n = 44 [52%]) fractures while femur fractures were less common (n = 10 [12%]). Many (n = 46 [55%]) were isolated injuries. Follow-up (1-year interviews and/or clinical follow-up of >90 days) was completed by 82 (99%) subjects (83 fractures). Overall, 9 (11%) primary closure subjects developed nonunion while 3 (4%) subjects had deep infections. Two of the 3 subjects with deep infection also developed nonunion. In the matched analyses of 68 pairs (136 subjects), mechanism of injury and associated injuries were similar

(P >0.36), but the delayed group reported more comorbidities (P = 0.009) and were more likely to receive external fixation (P = 0.001). The median time to operative management was similar between groups (P = 0.34), but median time to antibiotic administration was lower in delayed cohort (P = 0.009). Overall, there were more nonunions (n = 19 [29%]) and deep infections (n = 6 [9%]) reported in the delayed closure cohort than in the primary closure cohort (n = 8 [11%] nonunions; n = 3 [4%] deep infections) (P <0.001 for both; McNemar test for matched data).

Conclusion: In patients with lower/mid-Gustilo grade open fractures and wounds deemed clean at initial surgery, primary wound closure does not appear to increase the proportion of subjects who develop either deep infection or nonunion compared to delayed wound closure. Because this study was nonrandomized, further work is required to determine if primary wound closure reduces the development of nonunions and/or infections after open fracture.

See pages 47 - 108 for financial disclosure information.