Civilian Ballistic Arthrotomy: Infection Rates and Operative and Non-operative Management

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INTRODUCTION:

Infections resulting from gunshot wounds (GSW) are clinically important complications of firearm-related injuries that are seen and treated by many orthopedic surgeons. There is ongoing controversy over how best to manage traumatic arthrotomies. There is little evidence to support current best practices and most data comes largely from wartime studies of military populations. These findings may not be generalizable to civilian populations suffering low-velocity ballistic injuries of a different nature. The purpose of this study is two-fold: to report the rate of infection following ballistic arthrotomies and to determine whether there is a significant difference in rate of infection following a ballistic traumatic arthrotomy for patients who received operative treatment compared to patients who did not. We hypothesized no difference in infection rates between those patients treated with and without surgical irrigation and debridement (I&D).

METHODS:

A retrospective chart review at a single site from 2018-2022 was performed, screening for traumatic GSW-arthrotomies of major synovial joints. Intra-articular (IA) injury was established based on the presence of gas in the joint, fluid challenge with the saline load test, and presence of IA debris or fracture extension on X-ray and/or CT. Two cohorts were generated based on whether they received operative management (meaning irrigation and debridement) or non-operative management of their IA injury. The two cohorts were matched based on demographic factors and other possible confounding variables. Inclusion for analysis required a minimum of 30 days' follow-up. We also reported the overall rate of post-arthrotomy infections. The data were then analyzed using standard statistical tests including logistic regression, T-tests, and comparisons of proportions. In all cases, a p-value of 0.05 was used as the threshold for significance.

RESULTS:

700 patients had GSW-related extremity fractures with 270 patients having confirmed IA injuries. After exclusion, 109 patients remained and were separated into two cohorts based on operative management (meaning I&D) or non-operative management of their IA injury. 75 patients received operative management (group 1) and 34 patients received non-operative management (group 2). There were no significant differences in patient demographics or comorbidities between the two cohorts. However, the operative group had a significantly higher proportion of smokers than the non-operative group.

All patients in the operative group received antibiotics. In the non-operative group, 27 patients received antibiotics while 7 did not. All patients received bedside wound care. Overall, there were two incidences of infection, both of which occurred within the operative group. One infection occurred at the ankle joint, the other at the knee joint. Both patients were smokers but had no other comorbidities. The knee infection required a second I&D in addition to removal of infected hardware. The ankle infection required 11 repeat I&D surgeries in addition to revision of the initial fixation. There were no reported differences in infection rate ($p = 0.332$) and rate of secondary or revision surgery ($p = 0.337$) between the operative and non-operative cohorts. The most common indication for secondary surgery was foreign body removal, followed by external fixation removal with subsequent internal fixation.

DISCUSSION AND CONCLUSION:

This study found an overall infection rate of 1.8% with two cases of infection in 109 GSW-related arthrotomies, both of which occurred in the operative group. These rates are in-line with the numbers reported by Schultz et al. and Nguyen et al., who found superficial infection rates of 2.6% and 0% respectively. Our study includes a large patient population for this uncommon injury pattern and represents an in-depth study regarding management of traumatic arthrotomies. Although the reasons for operative management are often complex, our data suggests that non-operative management of ballistic arthrotomies is low risk and yields similar outcomes to operative management while perhaps sparing the patient an unnecessary surgery if I&D is the only goal of intervention. The findings of this study suggest that operative I&D of ballistic arthrotomies does not confer a significant advantage over non-operative management in terms of infection prevention.

Table 1: Infection rates in operative and non-operative groups	Group 1 (I&D)	Group 2 (Non-op)
No infection	73 (97.3%)	34 (100%)
Infection	2 (2.7%)	0 (0%)

Table 1. Comparison of proportions: 95% CI [-7.6% to 9.3%], no significant difference (p = 0.332)

Table 2: Rates of secondary surgery in operative and non-operative groups	Group 1 (I&D)	Group 2 (Non-op)
No secondary surgery	58 (77.3%)	29 (85.3%)
Secondary surgery	17 (22.7%)	5 (14.7%)

Table 2. Comparison of proportions: 95% CI [-9.4% to 21.5%], no significant difference (p = 0.337)

Table 3: Infection rates by joint	Shoulder	Elbow	Wrist	Hip	Knee	Ankle
No infection	10	18	4	14	45 (98%)	16 (94%)
Infection	0	0	0	0	1 (2%)	1 (6%)

Table 3. Comparison of infection rates by joint