Low Velocity Gunshot Wound Outcomes are Impacted by Bullet Type: A Novel Classification System

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INTRODUCTION:

At the 1899 Hague Convention, 26 international powers agreed to ban the use of deforming bullets during wartime conflicts due to the increased bodily harm caused to soldiers. This was further adopted by 18 more countries in 1907 as a means to protect humanity. These bullets are, however, readily available in the United States for purchase by civilians and law enforcement. Historically, gunshot wounds are classified into high-energy (>2000 ft/sec) and low-energy (<2000 ft/sec). Most handgun injuries are low-energy, however, may be heterogenous depending on the type of bullet used. We hypothesized that deforming bullets, such as hollow points, would cause significantly worse outcomes than full metal jacket rounds.

METHODS: A new 7-point classification system was created for identifying and predicting the type of projectile in a gunshot wound. This classification system included four categories: degree of comminution, soft tissue injury, bone loss, and radiographic fragmentation of bullet. Patient x-rays were evaluated and scored using the classification system by four senior orthopaedic surgeons. The classification system's sensitivity, specificity, and accuracy were assessed. Independent samples T-tests were used to compare the outcomes of the deforming bullet and full metal jacket cohorts.

RESULTS: Patients shot with deforming bullets had significantly longer total length of stay (14.5 vs. 7.6 days) and required more orthopaedic surgeries (2.1 vs. 1.4) than those shot with full metal jacket bullets (p<0.001, p=0.002, respectively). The mean sensitivity, specificity, and accuracy of the classification system were 87.2%, 92.6%, and 91.9%, respectively. The intra-rater and inter-rater reliability were substantial, with $\kappa = 0.77$ and $\kappa = 0.74$.

DISCUSSION AND CONCLUSION: Patients shot with deforming bullets demonstrate significantly worse outcomes in multiple categories compared to patients shot with full metal jacket bullets. The new classification system has substantial accuracy and inter-observer reliability. This system can be utilized by surgeons for preoperative risk stratification of gunshot wounds.

Reviewer Performance													
Review	Sensitivity		Specificity		Accuracy		DB vs FMJ: Relative Risk						
	Int	2nd	1st	2nd	lat	2nd							
Reviewer 1	84	94.6	100	100	93.2	96.2	Outcomes	DE(S)	FMJ (%)	83	99% CI	P Value	
Reviewer 2	76.1	91.3	90	90	80.3	90.9	Nonnine	8 (13.6)	1 (5.9)	23	0.51 - 17.2	0.415	
Reviewer 3	89.1	88	88.6	87	100	90.9	Fasciotens	13 (22)	2018	1.9	0.47 - 7.5	0.375	
Average	83.1	91.3	92.9	92.3	91.2	92.7	Incarcented Unon Discharge	6(00.7)	115.91	1.73	0.22 - 13.39	1.60	
							Loss of Reduction	2(3.4)	00)	1.5	0.08 - 29.8	0.79	
							Infection	13 (22)	3 (17.6)	12	0.40 - 3.9	0.701	
							Dehiscence	10 (16.9)	3 (17.6)	0.96	0.29 - 3.10	1.946	
							Blood Translesion	15 (25.4)	5 (29.4)	0.86	0.37 - 2.03	0.734	
							ED Visits	29 (48.2)	10 (51.5)	0.34	0.52-134	0.458	
							W. 5.00 1.1.1	12.025	4.000.00	4.84	A 44 A 44		

		DB vs FMJ: G		DB vs FMJ: Differ					
			Mean ± Stdev		Significance		· [
99% CI P Value 0.31 - 17.2 0.415		Variable	DB	FMJ	P Value				
0.47-15	0.375					8.			
1.22 - 13.39	0.600	Average Lea	Average Length of Stay (days)						
0.08 - 29.8	0.79								
0.40 - 3.9	0.701	First Admission	12.2 ± 12.2	20+52	0.0008				8-
0.29 - 3.10	1.946	1 104 1441100041	12.2 - 12.1 1.0 - 0.2		0.0000			1 3	60
0.37 - 2.03	0.734	Readmission	2.5 ± 6.9	0.6 ± 1.2	0.029				Sam .
1.52-134	0.458					6	DB FMJ		Optima
0.51 - 1.80	4.519	Total	14.5 ± 16.5	7.6 ± 5.2	0.0004	-			
		Average Nu	mber of Surj	peries					
		Orthopedic Surgeries First Admission	1.7 ± 0.9	1.3 ± 0.5	0.007				
		Orthopedic Surgeries Readmission	$0.4\ \pm 0.8$	$0.1\ \pm 0.3$	0.038				
		Orthopedic Surgeries Total	2.1 ± 1.4	1.4 ± 0.5	0.002				
		Non-Orthopedic Surgeries Total	1.6 ± 2.7	1.1 ± 1.2	0.142				