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ORIGINAL ARTICLE

Decision-Making in Gunshot Muskuloskeletal Injuries: A Systematic Review

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ABSTRACT

BACKGROUND: From January 2015 until January 2017, the treatment of patients with gunshot musculoskeletal injuries performed by the authors in an urban Trauma Hospital of Rio de Janeiro brought some controversies about surgical methods in Emergency Orthopedic Surgery. Therefore, data were revised in the literature to establish decision making in the primary management of these injuries.
QUESTION/PURPOSE: What are the aspects of decision-making in primary management of gunshot musculoskeletal injuries about fracture initial stabilization, soft-tissue management and antibiotic therapy?
MATERIAL AND METHODS/ RESULTS: The authors researched individually the combination of the terms "Fractures", "muskuloskeletal injuries", "Gunshot", "Management", "Treatment", "Trauma" and "Orthopedic Surgery" in MEDLINE, PUBMED, SCIELO and LILACS. 231 articles were related to Orthopedics and Traumatology. After criteria had been set, 15 articles were selected and organized in TABLES.
CONCLUSION: Gustillo grade I and II fractures treatment is based on debridement, immediate/early definitive internal fixation, and antibiotic therapy. Gustillo grade IIIA fractures can be treated with debridement and antibiotic therapy, reobservation of soft tissue conditions followed by definitive osteosynthesis. Gustillo grade IIIB and IIIC fractures of the long bones and joints can be treated with initial debridement and delayed internal fixation. More high level studies are necessary to determine if it is advantageous external fixation prior to definitive treatment of these fractures.

Key words: Management; Treatment; Gunshot; Muskuloskeletal injuries; Fractures

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INTRODUCTION

Wars and armed conflicts are part of human History since Before Christ in the Ancient Egypt and Mesopotamia. Through centuries,

Military Medicine had been trying to prevent soldiers from being badly injured or killed in the battlefield. The use of explosives, powder and rudimentary firearms was initially reported in China, around 700 AD. In 1536, Ambroise Paré, a French army surgeon who was treating wounded soldiers, discovered accidentally that a mixture from egg gems, rose oil and teritinbine had better effects in wound-healing than hot oil, that was commonly used[1]. Centuries later, the development of Penicillin antibiotic therapy in 1939 and intramedullary nailing for treatment of femoral fractures in World War II[1,2] contributed to the rapid rehabilitation of wounded soldiers. In World War II, the improvement of the protective equipment decreased thoracoabdominal injuries, highlighting injuries to the upper and lower limbs. Studies from different combat situations in the Second World War and the Vietnam War showed similar patterns to the anatomical distribution of injuries[1,2,3]. Another important point to the increased incidence of musculoskeletal gunshot injuries is that in combat tactics it is more advantageous to target the opponent in a limb than in the thorax, abdomen or head. In this way, the wounded combatant needs to be transported by other soldiers, reducing the offensive power of the enemy.

The increase in violence in large urban centers around the world has resulted in civilians also being injured by firearms, particularly in developing countries. In Brazil, epidemiological studies show that more than 40,000 people annually die from firearms[4], most of them young adult men (18 to 25 years old). More recently, it has been increasingly common to treat firearm injuries for military use in large urban centers and it has been difficult to differentiate lesions from civil and military conflicts, specially to prevent infection. Although contamination levels are higher in war zones, injuries to the urban civilian environment also present increased potential for contamination (Figures 1 and 2). Because of the easy access to military guns and explosives, high energy gunshot fractures are more frequent in civilian urban areas, challenging the Orthopedic Trauma Surgeon. Even in low energy fractures, doubts can be raised about antibiotics. There have been reports of drugdealers in Rio de Janeiro putting feces in the projectiles of their armaments[5]. As a matter of fact, most armed conflicts between the military and police against drugdealers occur in the "favelas," or "slums", poor communities which may have unhealthy conditions such as proximity to open sewers. Sometimes, environmental and social aspects are determinant to decisions about woundcare of antibiotic prophylaxis, especially in urban armed conflicts. Fixation methods are also controversial in high energy gunshot fractures and this is observed in the lack of standardization and studies with a high level of evidence to establish protocols on management and treatment of this type of injuries. The present review tries to gather information to contribute to decision making in the primary management of patients with gunshot musculoskeletal injuries based on scientific evidence.

Figure 1 High-energy gunshot to the elbow of a civilian patient managed (author's archive).

Question / Purpose

The different approaches of the authors of this study and the controversies found in the literature about gunshot musculoskeletal injuries primary management brought the following questions: What technique should be used for initial fracture stabilization and definitive fixation? What is the treatment for soft tissue lesions? Is antibiotic therapy necessary?

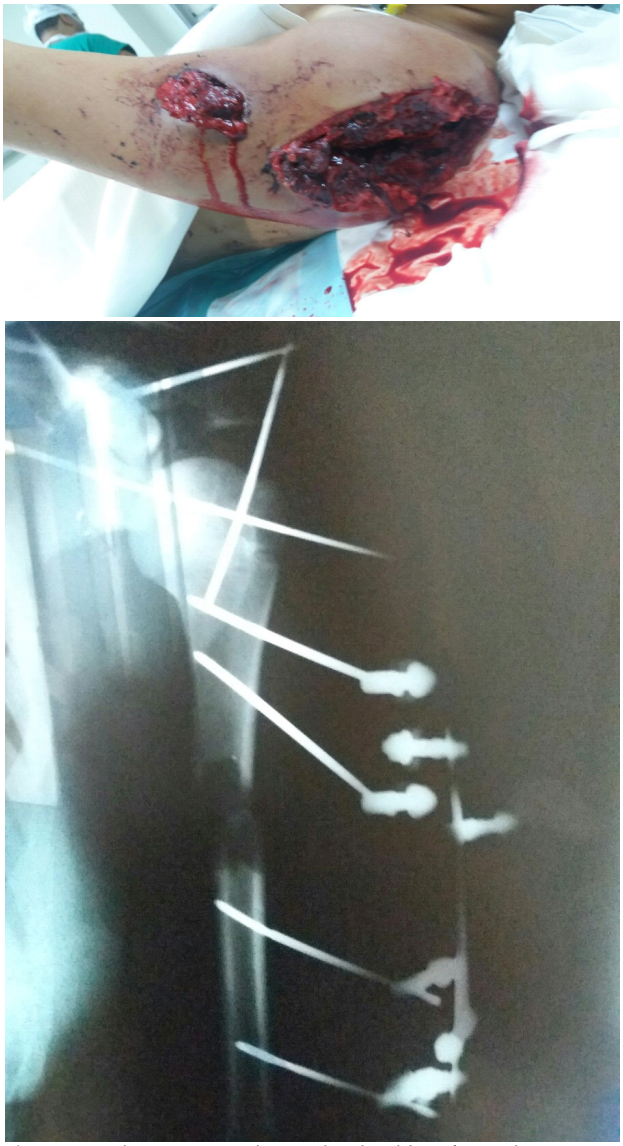

Figure 2 High-energy gunshot to the shoulder of a civilian patient managed with immediate debridement and External Fixation (author's archive).

Table 1 methods of fixation in gunshot muskuloskeletal fractures.

Author and Journal	Type of study and level of evidence	Population/ anatomical Segment	Follow-up	Methods of treatment	Results	Conclusion
Molinari[7]/ Cont Orthop 1994	Retrospective Comparative III	107 civilian patients with 121 extremity long bone fractures	10 yr	Immediate (A), early (B) and late (C) internal fixation groups	Infection 2.6% Nonunion 3.3% in each group	Early internal fixation reduced hospital length and costs
Nikolic[8]/ Injury 1999	Prospective Comparative	41 subtrochanteric fractures in military	--	External fixation (A) versus plaster of Paris (B)	Complications overall: 65%; infection: 15%; malunion: 10%. A-65% (delayed healing and nonunion; B-86.7% (contractures)	Both methods with a high rate of complications; external fixation facilitates care, stability, early covering of soft tissue defects and physical therapy.
Long[9]/ Clin Orthop Rel Res 2003	Prospective Comparative IIB	100 civilian Injuries to the femur	18 mth	Grade 1- Immediate nailing; Grade 2- And early nailing (48h later); Grade 3- late nailing (1 week later)	Grade 1- No infection Grade 2- 43% infection Grade 3- 50% infection	More correlation between the extent of tissue damage than treatment. Additional studies are required.
Amaral[10]/ Rev Bras Ortop 2007	Prospective Comparative Level II B	26 civilian patients with forearm fractures	62 mth	External fixation (group A) vs cast immobilization (group B)	A-Infection(21.4%) Nonunion(14.3 Compartment Syndr (7.2%). B-supine functional Loss (16.7%) full rigidity (16.7%) nonunion (8.3%)	A-good results (57.1%) B- good Results (58.3%) Both methods should not be used
Komurcu[11] Int Orthop 2008	Retrospective Comparative III	76 Civilian Patients With 92 hand fractures	12 mth	Immediate fixation for all plate fixation (A), K wire (B) and Ext Fixation (C), Plate + graft (D)	Infection 14.2% (A); 30% (B); 28.5% (C); 10% (D) Nonunion 0% (A, B) 7% (C); 10% (D).	Plate treatment better outcomes in handgun fractures
Polat[12] Eur J Trauma Emerg Surg 2018	Prospective Comparative Level II B	107 femur diaphyseal fractures in 99 civilian patients	76.3 mth	Immediate debridement and delayed treatment: External fixation (group A) versus Intramedullary Nailing (group B)	Deep infection 5.2% (A); 3.5%(B) Delayed union 10.5%(A); 7.1%(B) Nonunion 2.6%(A)3.5%(B)	No differences between the methods

Table 1B woundare in muskuloskeletal gunshot injuries.

Author and Journal	Type of study and level of evidence	Population/ anatomicalsegment	Follow-up	Methods of treatment	Results	Conclusion
Brunner[13] Am Surg 1990	Prospective randomized IIA	163 Civilian patients with injuries and no fractures	--	Local cleansing (A) versus debridement (B)	No infection both groups	Conservative management for low energy soft tissue damage without fractures is well indicated
Fries[14] Injury 2014	Prospective randomized Controlled Trial Level IIA	76 military patients with combat extremity wounds		Immediate debridement and nanocrystalline silver dressing (A) versus plain gauze (B control group)	A-colonized wound 42%; uncolonized wound 58%; not sampled 4% B-colonized wound 63%; uncolonized wound 12%; not sampled 7%	Importance of meticulous debridement to wound healing and avoid infection No differences between the methods
Maqungo[15] S Afr Orthop J 2017	Prospective randomized IIA	30 Intrartic wounds 29 civilian patients	20 days	Conservative treatm (A) versus Open arthrotomy Irrigation (B)	No infection Both groups	There is place for conservative treatment in intra-articular low energy gunshot wounds

Table 1C antibiotics in muskuloskeletal gunshot injuries

Author and Journal	Type of study and level of evidence	Population/ anatomical segment	Follow-up	Methods of treatment	Results	Conclusion
Woloszyn[16] Clin Orthop Relat Res 1985	Retrospective comparative III	132 fractures In 126 civilian patients	60 mth	Operative 12.8%; nonoperative 87.8% Intravenously antibiotics (A) versus oral antibiotics (B)	No infections	No differences between the methods
Dickey[17] J Orthop Trauma 1989	Prospective randomized IIA	96 civilian patients	--	All treated conservatively Antibiotic (A) versus Nonantibiotic (B) infection prophylaxis	2.7% infection both groups	No differences between the methods
Geissler[18] J Orthop Trauma 1990	Prospective comparative IIB	25 civilian patients	--	Local irrigation, debridement, Intramuscular Atb and casting (A) VERSUS Local debridement and 48h intravenous Atb (B)	4% infection both groups	Low-velocity Gunshot-induced fractures can be managed without intravenous antibiotics
Hansraj[19] Orthop Clin North Am 1995	Prospective comparative	100 patients with fractures in civilian	--	Ceftriaxone vs Cefazolin	No infection	Ceftriaxone can be used in a single dose and reduced the length of hospitalization
Knapp[20] J Bone Joint Surg 1996	Prospective randomized IIA	222 long bone fractures in 199 in civilian patients	--	All conservative; Intravenous Antibiotics (A) versus Oral Antibiotics (B)	1% infection Both groups	Oral and IV ATB are equally effective

Table 1D woundare in muskuloskeletal gunshot injuries.

Author and Journal	Type of study and level of evidence	Population/ anatomical segment	Follow-up	Methods of treatment	Results	Conclusion
Dunne[21] J Trauma 2009	Prospective Comparative IIA	20 military patients with Combat extremity wounds	13 mth	Blood transfusions. <or = 4U Blood (A) versus >(B) 4U Blood	A- woundhealing 9%, ICU admission rate 9%, infection 27% B-woundhealing impairment-54% ICU admission rate-78%, infection 89%	A-less complications B-more complications, more inflammatory factors

MATERIAL AND METHODS

The authors researched the terms "Fractures", "muskuloskeletal lesions", "Gunshot", "Management" and "Treatment" in MEDLINE, PUBMED, SCIELO and LILACS. From this primary research there were 181 articles were related to Muskuloskeletal Trauma Surgery, mostly published in Orthopaedic and Traumatology scientific journals. In order to realize a good quality review, the authors stablished the criteria below:

A. Inclusion criteria: (1) Patients that were treated with gunshot injuries to the extremities and limbs; (2) Clear description of the population; (3) Clear description of the treatment; (4) Clear description of the outcomes; (5) Comparative Prospective/ Retrospective case studies; (6) Articles published from 1955 to 2019.

B. Exclusion criteria: (1) Epidemiologic studies; (2) Basic science studies; (3) Other Revision Articles; (4) Expert opinions; (5) Articles involving patients with skeletal immaturity; (6) Spinal injuries; (7) Descriptive non-comparative studies.

RESULTS

A bibliometric analysis article was published by Held[6] and the study evaluated the most cited articles from 1950 to 2018 on the subject. Of the 128 selected studies, most of them were retrospective descriptive non-comparative, with low level of evidence. This systematic review was based on comparative studies with a higher level of evidence. From the 231 articles searched about gunshot muskuloskeletal injuries, 15 were selected after inclusion/exclusion criteria. All of them were comparative studies, 12 prospective (80%) and 3 (20%) retrospective. From these 15 articles, 6 focused on fracture fixation surgical methods (40%), 3 woundcare (20%), 5 on antibiotics (33.3%%), and 1 blood transfusion (6.7%). According to the methods of treatment highlighted, the articles were organized in Table 1 (A, B, C).

6 articles were organized on TABLE 1A. Molinari[7] and Long[9], in comparative studies with low energy gunshot fractures of the femur in civilians, had good results treating them with immediate intramedullary nailing and low rates of infection (2.5% and 0%, respectivelly). Molinari performed a comparative analysis of 121 low-speed firearms fractures of long bones at a hospital in New York City, putting them in 3 groups according to the internal fixation time (immediate, early and late). No diferences were found and the study concluded that early internal fixation is related to reduced hospital lenght of hospitalization (Table 1A). Long[9] studied 100 fractures of the dyaphisis of the femur and graded according to the level of contamination in 1, 2 and 3. Immediate nailing was performed in Grade 1 fractures, early nailing (48h later) in Grade 2 and late nailing in Grade 3 (1 week later). The infection rate was 0% in grade 1, 43% in grade 2 and 50% in grade 3. The study concluded that infection was more related to the extent of damage than to the method of fixation and highlighted debridement. Polat[12] analysed 107 low energy diaphyseal femur fractures, comparing delayed external fixation and delayed nailing and no diferences were found between these methods. Nikolic[8], analysing 41 subtrchanteric fractures in military, compared external fixation and plaster of Paris, finding high rate of complications in both. Komurcu[11], in a retrospective comparative study about low energy gunshot fractures of the hand, concluded that plate fixation had better results than K wire, external fixation and plate with bone grafts. Amaral[10] had good results in less than 60% of the cases in a study comparing Debridement plus External Fixation versus Debridement plus Casting in High Energy Gunshot-induced forearm fractures, not recomending none of these techniques. On Table 2, it can be observed the number of articles that recommended primary, early and late fixation, the anatomical regions treated and the implants used:

Table 2 prefered methods of fixation.

Time of fixation	Anatomical region/ energy of gunshot/ implant used
Primary Fixation (Immediate)[2]	1. Hand/ Low energy/Plate Fixation
	2. Femur Grade1 / Intramedullary Nailing
Primary Fixation (Early 48h)[2)]	1. Long Bone Low Energy/ Internal Fixation
	2. Femur Grade 2/ Intramedullary Nailing
Late Fixation >48h[2]	1. Diaphyseal Femur Low Energy/ Intramedullary Nailing
	2. Femur Grade 3/ Intramedullary Nailing
Inconclusive[1]	1. Forearm/ High Energy/ External Fixation not indicated

3 articles focused on woundcare (Table 1B). Brunner[13] analysed injuries of soft tissue without fractures, comparing cleansing and debridement with no infections in both groups. Debridement was indicated in all gunshot-induced fractures. Fries[14] studied local woundcare of 76 military with extremity wounds in the battlefield and debridement was also related to better healing and lesser infections. Maqungo[15], in a pilot study compared conservative treatment and open arthrotomy in 30 intrarticular wounds in civilian patients, with no infections in both groups, concluding that there is place for conservative treatment in these injuries.

5 articles were organized (Table 1C) focused on antibiotics and all of them were about low energy gunshot injuries. Woloszyn[16] and Knapp[20] compared oral and IV antibiotics therapy and had very low rates of infection (0% ranging to 1%). Dickey[17] compared antibiotic and nonantibitic therapy and Geissler[18] compared IM and IV antibiotics (0% ranging to 4%) These studies had similar results, with low rates of infection and no diferences between the analysed methods. Hansraj[19] had 1% of infection in a comparison between ceftriaxone in a single dose and cefazolin, and prefered ceftriaxone because of the reduced lenght of hospitalization.

The highest rates of infection in low energy gunshot injuries were found hand fractures treated with k wire (30%) and external fixation (28.5%), most superficial. Deep infection was not found in low energy injuries in this review. Nonunion had a very low rate in low energy gunshot injuries, ranging from 0 to 10%.

In high energy gunshot-induced fractures the rates of complications were higher[11]. Femur Grade 3 fractures had 50% of infection[9]. Forearm high energy fractures reached 21.4% of infection rate and 16.7% of loss of function[10]. Blood transfusion in military casualties with combat extremity wounds was related to high woundhealing impairment (54%), high ICU admission rate (78%) and high Infection (89%)[21].

DISCUSSION

Early care is fundamental for good results and avoiding hemorrhagic chock and infections, the main causes of mortality and morbidity in gunshot injured patients. In the Wars in Iraq and Afghanistan, the speed in aeromedical transport and training in Trauma Life Support with control of bleeding were crucial for effective care of wounded soldiers[22].

After the ABCDE Trauma Primary Evaluation and Management, gunshot-induced fractures are classified, one of the first steps of orthopedic evaluation. Historically, gunshot wounds are divided in high and low velocity. The results from studies on ballistics obtained in the literature showed that the impact of the injury on the tissue in

the moment of impact, the anatomical site affected, the distance from the shot and the degree of bone comminution[23,9] are more important than velocity to characterize the injuries. Fackler[23] observed that speed is only one of the severity factors of the injury, not taking it as a single criterion. Nevertheless, the Gustillo Classification[24,25] for open fractures remains the most important and used parameter for assessing gunshot fractures. Long[9] correlated the low speed lesions like Type Gustillo I Lesions and high speed lesions like Type Gustillo III. Another factor that affects the prognosis of these lesions is the time elapsed between injury and hospital care and contamination levels can rise after 6h, even in low energy fractures.

Decision-Making In Low Energy Injuries

After classification of muskuloskeletal injuries, it is importan to decide the type of treatment (conservative or operative). Low energy uncomplicated injuries tend to be treated conservativelly. 2 prospective randomized studies had similar results in low energy injuries[13,15]. Brunner[13], in a prospective randomized study with 163 extremity injuries in civilians with no fractures did not find infections, concluding that conservative management for low energy soft tissue damage of the extremities without fractures is well indicated. Maqungo[15] indicated conservative management for low energy intrarticular gunshot uncomplicated injuries. In Intrarticular retainned bullet it is necessary excision, like in Figure 3.

Other important decision is the use of antibiotics. The results of the present Systematic Review are very similar to the Systematic Review of Papasoulis[26], that concluded that the use of antibitiocs in low energy injuries by firearms treated conservativelly can be discarted.

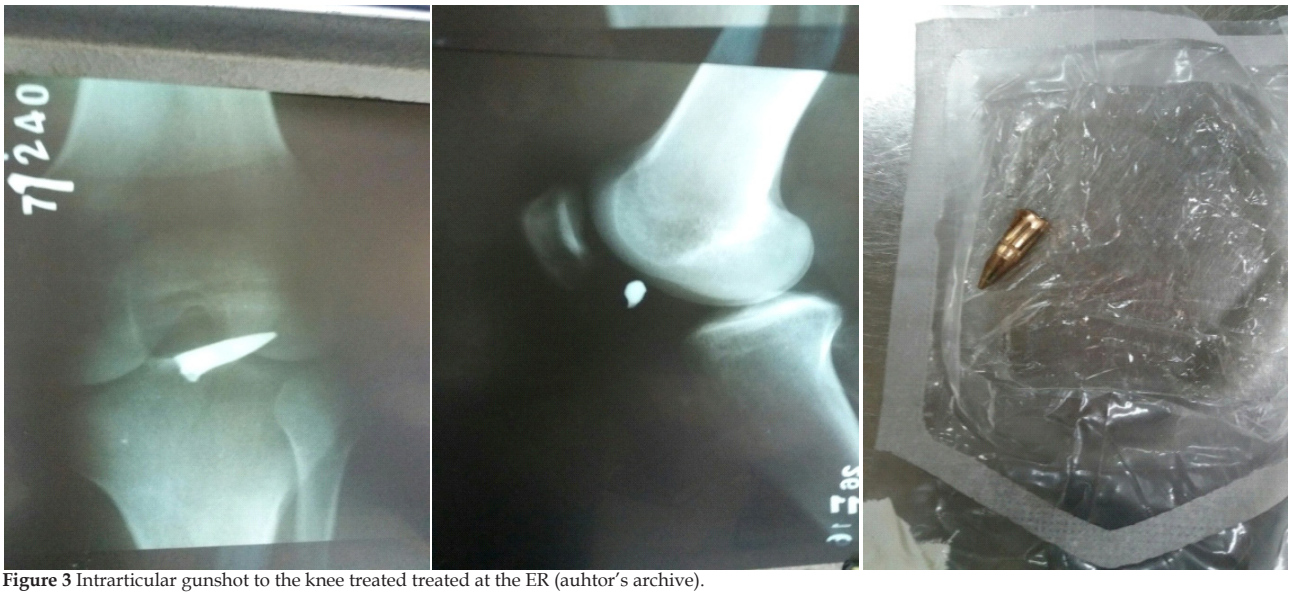

Figure 3 Intrarticular gunshot to the knee treated treated at the ER (auhtor's archive).

Figure 4 Gunshot-induced fracture of the diaphysis of the femur treated by debridement and temporary external fixation at the emergency (author`s arquive).

The antibiotics of choice are the cefalosporins, cefazolin, with similar efficacy through IV or oral administration. It seems to be a consensus that more conservative management is well indicated in low energy gunshot injuries. This is very important because of bacterial resistant and high health administration costs.

Decision-Making In High Energy Injuries

High energy injuries are treated surgically. In its primary management there is a consensus that meticulous debridement is one of the most important step to avoid complications. Fries[14], in a prospective randomized study compared the level of contamination of wounds in the battlefield using nanocrystalinne silver dressing and plain gauze. The study did not find relevant differences and concluded that debridement was the main factor to prevent infection. Long[9], in a prospective analysis of retrospective data, compared the results of the treatment of 100 femur fractures in civilian patients and highlighted the importance of evaluation and management of soft tissue with debridement to reach better results and avoid infections. Blood transfusion was studied by Dunne[21] in a randomized trial with 20 military patients in combat casualties to the extremities and concluded that blood transfusions of more than 4 units is related to more complications in postoperative period, which challenges trauma surgeons decision-making in these life-threatening injuries.

Setting Of Management And Complications In Low Energy Injuries

Some low energy injuries can be treated conservatively or nonoperative. According to the present Review, it can be said that when surgical methods are necessary the treatment of choice is immediate primary definitive fixation. Komurcu[11], in a retrospective comparative study with 76 fractures of hand by low energy firearms, concluded that immediate internal fixation with plate is the better option for these injuries. Kiehn[27], in a restrospective descriptive study pointed immediate definitive fixation methods as the best choice for definitive fixation in hand fractures by low energy firearms. Gonzalez[28], in a retrospective descriptive study with hand fractures by low energy firearms had 12% of pseudoarthrosis using plate with graft, similar to Komurcu, that had 10% of pseudoarthrosis with this technique, but still inferior than plate result (0% of pseudoarthrosis).

In the 1990s, retrospective descriptive studies assessed the treatment of gunshot-induced femur fractures by early intramedullary nailing, and all had good results and low rates of complications[29-33]. The main limitation of these studies was the low level of evidence. In the present review, the study of Polat[12] performed a retrospective comparative study with 107 gunshot-induced femoral fractures in 99 patients and divided them into 2 groups, 1 treated with an intramedullary nailing and another with external fixation. The mean follow-up time was 76.3 months and no significant difference was observed in relation to the rates of postoperative complications. One of the limiting factors of this study was the fact that it did not show the differences in the levels of contamination of the groups at the initial moment of the trauma. This Review points to debridement and immediate intramedullary nailing as the treatment of choice for femoral gunshot fractures and brings us back in time to the classic studies of Kuntscher[2] on World War II, that revolutionized Military Medicine and Orthopedics with rapid recovery of these patients using intramedullary nail. Nowadays, the offensive power and energy of gunshots allied to the rise of bacterial resistant to antibiotics could lead to a more aggressive management for long bones fractures by firearms, but Gustillo 1 fractures can be treated by immediate internal fixation with good results in urban centers. Early treatment of femoral diaphyseal fractures by low- and medium-velocity firearms with early intramedullary nailing in well-structured civilian hospitals may be recommended.

Setting Of Management And Complications In High Energy Injuries

Leffers[34] observed more complications in intermmediate and high-energy tibial fractures in civilian. Possley[35] had a 77% successful treatment of combat-related open tibia fractures with external fixation. The USA and Western Europe had the hegemony of publishing, but in the last decades trauma centers in Eastern Europe, Asia, Africa and Latin America reported their experiences. Dubravko[36] retrospectively evaluated 116 arms fractures in the Croatian war treated with external fixator and the main complications were tract pins infection (35.34%), osteomalacia in the pin (18.10%) and osteomyelitis (7.7%). Kaguru[37], in a study carried out in Congo, Africa, treated 62 patients with firearm fractures with external fixation and venous antibiotic therapy and had a total of 27.41% of complications. Lerner[38] performed a retrospective analysis of 64 high-energy fractures by firearms initially treated with tubular fixator, delayed primary closure, skin grafts, or tissue replacement flaps later replaced with Ilizarov-type external Fixation after 5-7 days. In 90.8% of cases, bone healing was achieved after 8 months. Dahabra[39] evaluated 60 firearms fractures in a hospital in Jordan, 25 of them for low speed and 35 for high speed, at an average follow-up of 26 months. All cases were treated with debridement, antibiotic therapy and external fixation. Olasinde[40], in a prospective study with 28 patients and 31 firearms fractures in a civilian hospital in Nigeria, observed 71.4% femoral fractures and 29.6% tibial fractures. These patients were treated with intramedullary nail and 15.2% had infection. Abghari[41], in an analysis of 148 injuries in 133 patients with low energy fire injuries treated at a civil hospital in Jamaica, performed a retrospective comparative analysis of the evolution, length of stay and type of operative treatment or non-operative. The total complication rate was 15%, 6.1% of vascular injury, 1.4% of nerve damage, 5.3% of acute infection, 2.3% of compartment syndrome, 0.8% with amputation and 0.8% with a need for surgical revision. Abalo[42], In a study done in Togo, West Africa, evaluated 64 patients with 64 firearm fractures with a protocol of debridement and venous antibiotic therapy followed by internal fixation according to soft tissue evolution with immediate closure of the operative incisions and late of the entrance and exit of the projectiles. In cases of associated lesions (vascular, nervous and compartment syndrome) or comminuted type C fractures, the infection rate was, respectively, 68.4% and 29.3%. There was a significant correlation between infection, bone comminution and intramedullary internal fixation observed in this study.

There is a tendendy to external fixation in war zones and heavy urban armed conflicts[43], because of the difficulties of access and transportation of the injured victims to big trauma centers, as it is showed below (Figure 4). Dar[44], in a prospective study assessed 41 patients with high-velocity gunshot-induced femur fractures treated with initial external fixation followed by blocked intramedullary nailing. After an average period of 26 months, all fractures consolidated with satisfactory alignment. No case of deep infection and 12.2% of cases of superficial infection were observed. The main complication was a decrease in range of knee movements (43%), probably due to adhesions in the quadriceps muscle due to surgical manipulation. These studies are limited by their low level of evidence. Most controversies about Muskuloskeletal Injuries are related to the setting of definitive management of high energy

gunshot-induced fractures. In this Review, 3 articles with higher level evidence studied high energy gunshot-induced fractures. Long[9] had high infection rates treating femoral high energy gunshot-induced fractures with nailing and Nikolic[8] had poor results in subtrochanteric fractures with external fixation. Amaral[10] pointed to bad results with external fixation of forearm high energy fractures in a comparative study with debridement and immobilization. The present review was inconclusive about the time of definitive internal fixation for high energy gunshot-induced fractures. Fang[45], in a methanalysis comparing intramedullary nail and external fixation in Gustillo 3 tibial fractures was not conclusive about the best choice, but points that surgeons subjectelly prefer external fixation followed by nailing, giving to much attention to infection and sometimes forgetting that this procedures can also raise infection rates, because of reoperation, more time of hospitalization and higher malunion rates. As a matter of fact, more comparative studies with high level of evidence are necessary.

CONCLUSION

Injuries to soft tissue and low energy gunshot uncomplicated fractures can be treated conservativelly with cleansing and no antibiotics. For the management of Gustillo grade I and II fractures treated less than 6 hours after the initial trauma treatment is based on debridement, immediate/early definitive internal fixation, and antibiotic therapy. Gustillo grade IIIA fractures can be treated with debridement and antibiotic therapy, reobservation of soft tissue conditions followed by definitive osteosynthesis. Gustillo grade IIIB and IIIC fractures of the long bones and joints can be treated with initial debridement and delayed internal fixation. More high level studies are necessary to determine if it is advantageous external fixation prior to definitive treatment of these fractures.

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