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Importance of External Fixation in Primary Treatment of War Wounds to the Extremities

Predrag Grubor[1], Milan Grubor[2], Ivan Golubović[1], Predrag Stojiljković[1], Zoran Golubović[1,3]

[1]*Orthopaedics and Traumatology Clinic Banja Luka, Republic of Srpska, Bosnia and Herzegovina*
[2]*School of Medicine Banja Luka, Republic of Srpska, Bosnia and Herzegovina*
[3]*University of Niš, Faculty of Medicine, Serbia*

SUMMARY

A war wound is damage to the body having great kinetic energy, inflicted by firearms, (blast, projectile, burn) and sustained in wartime. It is characterised by massive destruction, primary contamination and modified reactivity of the body.

The aim of this retrospective study was to show how to primarily treat the injured extremities, with and without fractures, as well as how to select the method for stabilizing fractured bones.

The study involved 2.462 wounded persons. They sustained injuries to the extremities, abdomen, thorax and head, and, having sustained the wounds, they received primary surgical treatment at the Orthopaedics and Traumatology Clinic in Banja Luka in the period between September 15, 1991 and December 1, 1995. Out of the 2.462 wounded subjects, 122 (4.59%) were women, 24 (0.9%) were children and 2.269 (94.15%) were men. The average age of the wounded was 33.73 years. Two hundred sixty-five (10.77%) subjects sustained muscular and cutaneous injuries to the extremities, without bone fractures, and 2.197 (89.23%) wounded persons had broken bone fragments that required stabilisation after the primary surgical treatment. Out of the 2.197 wounded persons with broken bones, 2.043 (92.43%) sustained cumminuted fractures with or without bone defects. In 1.573 (72%) cases, broken bone fragments were primarily stabilized using external fixators, in 531(24%) cases plaster cast and plaster cast in combination with Steinmann pins and Kirschner needles, and in 91(4%) cases we used extension.

The most commonly encountered complications with external fixators use were as follows: 86 (5.46%) pin tract infections, 3 (0.19%) pin breakages, 42 (2.66%) fixator reassembly procedures due to inadequate primary placement of the external fixator, 6 (0.38%) iatrogenic vascular lesions inflicted with the drill or pin and 4 (0.25%) iatrogenic nerve lesions.

The complexity, specific nature and originality of every war wound require expertise, experience, attention and diligence. Every patient is a separate entity and they require an active attitude throughout the course of treatment.

The experiences gained in the last war (working with 28 types of external fixators) and the results obtained give me the right to maintain that the method of choice for primary stabilisation of bone fragments in war wounds is Mitković's external fixation type M20.

Key words: **External fixation is Mitković's type M20**

Corresponding author:

Predrag Grubor •
phone: 00 387 65 513 115•
e-mail: predraggrubor@gmail.com •

INTRODUCTION

When a war ends, people no longer talk about war surgery. Meanwhile, military technology is developed, perfected and becomes more and more sophisticated. Any next war then catches surgeons unprepared because they bring into this new war experiences dating from the previous war, without knowledge of new technologies which are more devastating than those from before. In the epidemiology of war trauma, a surgeon gains experience quickly, irrespective of the fact that the number of surgeons compared to the number of the injured is disproportionate and detrimental to both sides (1).

A war wound (Figure 1) is damage to the body, inflicted by firearms (blast, projectile, burn) and sustained in wartime. It is characterised by massive destruction, primary contamination and modified reactivity of the body (2). The treatment of a war wound starts with primary treatment of the wound, which must be 'sterilisation of the war wound'. In order to achieve this, the injured extremity is washed under an anaesthetic with a brush, soap and warm water. Having washed the extremity, the underwear and gloves are changed, and the surgical site is prepared following all aseptic postulates (3). A war wound needs to be flushed out with up to 10 litres of physiological solution which mechanically removes dead tissue and foreign bodies (4).

Primary treatment of the skin is done by making an incision of up to 2 mm into the healthy skin. The skin is relatively well vascularised and infection resistant (4). Subcutaneous adipose tissue is poorly vascularised and infection intolerant and it is thus necessary to make an excision up to 5 cm from the wound edge (5). The 4 C's rule (contractility, capillary bleeding, colour, consistency) should be followed when primarily treating muscle tissue. Bone fractures are multi-fragmented (95%), dislocated, deperiosted and accompanied by bone defects (6).

Following the primary treatment of a war wound, it was necessary to immobilise the injured extremity. Adequate immobilisation of the broken bone enables the injured person to become mobile relatively quickly, not to feel pain and to have the wound re-dressed less frequently (7). No matter how surgically perfect haemostasis after the primary treatment of a war wound is, gauze eventually becomes soaked with blood and antiseptics, and it jeopardises the sterility of the wound (8).

We used the following for immobilisation: plaster cast, plaster cast in combination with Kirschner needles and Steinmann pins, extensions, external fixators (1).

By seeing a large number of injured persons on an everyday basis, one realises that the selection of immobilisation methods for injured bones has a major effect on the amount of the material used, number of surgical interventions, morale of the wounded and medical staff, i.e. on the final result (9).

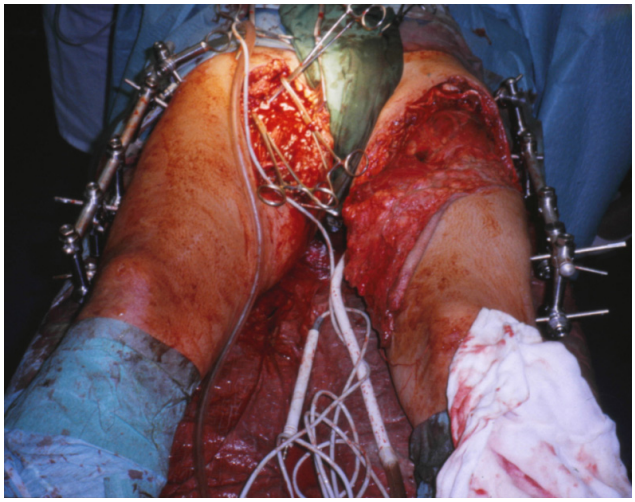

Figure 1. *Primary treatment of war wounds of thigh with fractures stabilized by external fixator M20*

AIMS

This retrospective study, covering the period between September 15, 1991 and December 1, 1995 shows the ways to primarily treat 2.462 wounded persons with extremity injuries who received their primary treatment at Banja Luka Clinical Centre. The injuries were the result of the impact of a great kinetic energy on the extremities. Special emphasis is given to the selection and methods for stabilising the fractured bone fragments.

MATERIAL AND METHODS

This study involved 2.462 wounded subjects, with injuries to the extremities and multiple combined injuries to the abdomen, thorax and head, who received their primary surgical treatment at the Orthopaedics and Traumatology Clinic in Banja Luka in the period between September 15, 1991 and December 1, 1995. Out of the 2.462 wounded persons, 122 (4.59%) were women, 24 (0.9%) were children and 2.269 (94.15%) were men. The oldest wounded woman was 82 years old (born in 1914), the oldest man was 87 (born in 1908), and the youngest child was 3 (born in 1992). 1654 (67.18%) of them had all documents on their persons (first and family name, place of living, military post, vaccination data, etc). The average age of the wounded subjects was 33.73 years.

Due to sustained wounds, 265 (10.77%) of them needed to receive the primary treatment of muscular and skin injuries to the extremities, and 2.197 (89.23%) subjects, in addition to this, needed to have their broken bone fragments stabilized. 2.043 (92.43%) of them sustained comminuted fractures with or without bone defects. In the first months of the war, we used plaster cast or a combination of plaster cast and Kirschner needles and Steinmann pins, as well as a small number

of external fixators found in the hospital, to stabilize the bone fragments and immobilise the extremities.

At the beginning of the war, we used plaster cast to immobilise injured extremities. No matter how surgically perfect haemostasis after primary treatment of a war wound is, gauze and plaster cast eventually become soaked with blood and antiseptics and that jeopardises the sterility of the wound. Changes of the plaster cast are painful and there is a great possibility that the fragments will not be adequately repositioned.

During the war, I used extension as a treatment method mostly temporarily, due to the lack of external fixators or until initial callus formation. This method causes long-term dependence of the wounded person on other people's assistance, discomfort, immobility, long hospital bed occupancy.

The epidemic of war trauma (10) soon convinced us that the injured persons for whom we used external fixators suffered fewer complications and had better results.

The more experience we gained, the more I preferred stabilization by external fixation. This was best seen in the last six months of the war when, in the period between June 15 and December 1, 1995 (time of major military operations), we stabilised bone fragments with external fixators in 92% of cases (Table 1).

In the period between 15 September 1991 and 1 December 1995, we stabilized 72% (1573 external fixators) of cases with external fixators; 24% (531) with plaster cast and plaster cast in combination with Steinmann pins and Kirschner needles; 4% (91) with extensions (Table 2).

Table 2 shows that plaster cast immobilization is implemented more often in case of injuries to the hands and feet, while external fixators are used for long bones. We stabilized with 14 different types of external fixators, using Mitković's fixator M20 in 1.342 (85%) cases and other types in 234 (15%) cases (Table 3).

I always use functional plaster casts (Coldwell, Mooney, Delbeto, Sarmiento) after taking off the external fixator, which was placed on the injured extremity for 40 days on average.

As early as the beginning of 1992 we had to manufacture external fixators because everyday practice favoured stabilization with external fixators. Although Čajavec company had the technological capacity to manufacture any type of external fixators, earlier experiences made me opt for the use of Mitković's external fixator type M20. It was easy and cheap to manufacture. The M20 is a unilateral external fixator with a great mobility of movable clamps and pin holders which enables the placing of convergent bone pins, which, if necessary, is used at different stages of the treatment to adequately stabilize, neutralise and biocompress the extremity, and which provides easy access to the wound at all times. It is rarely indicated (bone defects exceeding 5 cm) to assemble a bilateral, triangular or semi-circular frame from a unilateral one, by placing Kirschner needles with olives, the distraction osteogenesis method is used (Figure 2, Figure 3).

In minor pin tract infection, the pin is removed in order not to develop major infection, and the mobility of the clamp and pin holder allows the placement of another pin under local anaesthesia in order to keep the same stability. One spanner is necessary for the assembly of the frame and, most importantly, it is easy to train doctors who have never worked with external fixators on how to use them.

Table 1. *Stabilization method for bone fragments in subjects injured by firearms in the period June 15 - December 1, 1995*

Injured extremities	No.	External fixator	Percentage	Plaster cast Steinmann pin Kirschner needle	Percentage	Extension	Percentage
Upper leg	81	78	96.30%	0	0.00%	3	3.70%
Lower leg	122	122	100.00%	0	0.00%	0	0.00%
Upper arm	61	52	85.25%	9	14.75%	0	0.00%
Lower arm	47	34	72.34%	13	27.66%	0	0.00%
	311	286	91.96%	22	7.00%	3	0.96%

External fixator	286
Plaster cast, Steinman pin, Kirschner needle	22
Extension	3
	311

Table 2. *Overview of extremity fractures and primary treatment methods in the period September 15, 1991 - December 1,1995 in Banja Luka CHC*

Injured extremities	No.	External fixator	Percentage	Plaster cast Steinmann pin Kirschner needle	Percentage	Extension	Percentage
Upper leg	590	509	86.27%	9	1.53%	72	12.20%
Lower leg	695	589	84.75%	87	12.52%	19	2.73%
Foot	126	5	3.97%	121	96.03%		0.00%
Upper arm	388	297	76.55%	91	23.45%		0.00%
Lower arm	255	159	62.35%	96	37.65%		0.00%
Hand	141	14	9.93%	127	90.07%		0.00%
	2195	1573	71.66%	531	24.19%	91	4.15%

Table 3. *Types of external fixators*

External fixator types	No.
Hoffman	62
Oganesian	3
Ortofix	32
Charnley	42
AO	12
Sherer	14
MMA Belgrade	9
Aesculap	12
French fixator	4
Mitković-M9	18
Instrumentar. Zagreb	15
Srakar	8
Kotajev	3
Mitković-M20	1342
	1576

Figure 2. *Compensation of bone defects by distraction osteogenesis of external fixator M20*

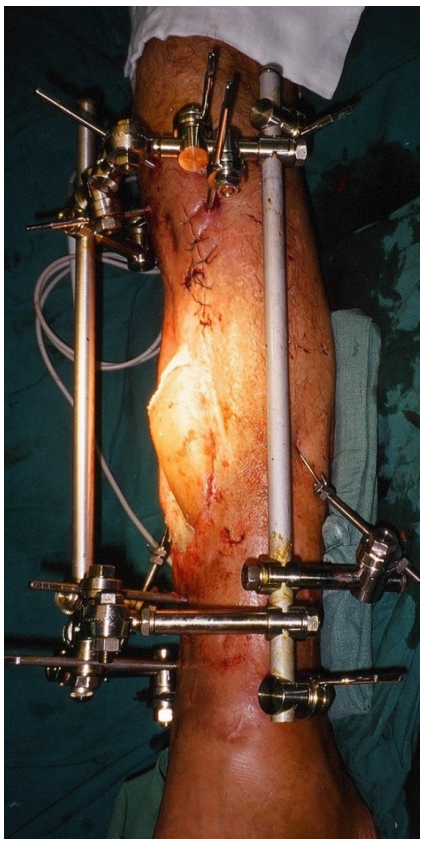

Figure 3. *Installation of external frame of fixator M20 using the method of distraction osteogenesis*

RESULTS

In the course of primary treatment of the 2.642 persons injured with firearms we experienced some complications with the functioning of external fixators and complications resulting from primary treatment of wounds.

The complications we experienced in working with external fixators were as follows: 86 (5.46%) pin tract infections, 3 (0.19%) pin breakages, 42 (2.66%) fixator reassembly procedures, 6 (0.38%) iatrogenic vascular lesions inflicted with the drill or pin and 4 (0.25%) iatrogenic nerve lesions (Table 4).

There were infections of muscle and cutaneous tissue, acute osteomyelitis (re-intervention sites) in 704 (28.59%) wounded persons. Despite the surgical and drug therapies, there were 74 (2.92%) cases of chronic osteomyelitis, classified by bones as follows: humerus 7, radius 4, ulna 5, femur 21, tibia 31, calcaneus 3, metatarsal bone 1. There were 5 (0.2%) cases of gas gangrene. The bacteria derived from bacteriological analysis had the following percentages: Staphylococcus aureus 51.38%, Pseudomonas spp. 13.82%, Pseudomonas aeruginosa 12.50%, Enterobacteriaceae 5.50%, other 8.40%, mixed infections 8.40%. Out of the 2.642 wounded persons, re-intervententions were performed in 704 (28.59%) individuals, and out of that number 491 (69.73%) re-interventions were performed following the primary treatment of the wound, where stabilization was undertaken by plaster cast or with plaster cast in combination with Steinmann pins and Kirschner needles, or extensions. The reasons for performing re-interventions were as follows: change of plaster cast because it was soaked with blood, plaster cast maceration, inadequate position of bone fragments, and secondary infection of the war wound.

Out of the 1573 applied external fixators, 213 (13.54%) were used for re-interventions.

If we analyse the injured with multiple injuries (Table 5), we see that it is very difficult to achieve adequate stabilization and mobility with any other method but external fixation.

Table 4. *Complications related to external fixators' use*

Complications	No.	Percentage
Pin tract infection	86	5.46%
Pin breakage	3	0.19%
Fixator reassembly	42	2.66%
Vascular lesions	6	0.38%
Neurological lesions	4	0.25%

Table 5. *Presentation of multiple injuries*

Injury	No.	Percentage	Arterial injuries	Nerve injuries
Upper leg	590	26.88%	a. femoralis 102 (17.29%) a poplitea 13 (2.20%)	nervus ischiadic 4 (0.67%)
Lower leg	695	31.66%	a tib. comunis 8 (1.15%) a. tib. posterior, anterior, fibularis 12 (1.72%)	nervus peroneus 3 (0.43%)
Foot	126	5.74%	95 feet injuries accompanied by injuries to the abdomen, thorax, lower leg, 31 injuries to the foot only	
Upper arm	388	17.68%	a. brachialis 37 (9.53%)	nervus radialis 38 (9.79%)
Lower arm	255	11.62%	a. radialis and a. ulnaris 10 (3.92%)	
Hand	141	6.42%	105 hand injuries accompanied by injuries to the abdomen, thorax, ..., 36 injuries to the hand only	
Total	2195	100.00%		

Out of the 2462 wounded persons, the following sustained multiple injuries:	Abdomen: 98(3.98%) Thorax: 25 (1.01%) Craniocereb.: 34(1.38%)

DISCUSSION

The complexity, specific nature and originality of every war wound require expertise, experience, attention and diligence (9).

War wounds were most frequently localized on the extremities - 70% (2,10), of which number 40% were accompanied by bone fractures (11). Piščević maintains that one third of gunshot wounds to the arteries is accompanied by fractures (12). Z.Popović states that joint injuries in this war occurred in 5.7% of cases, of which 57.3% of cases were penetrating joint injuries. Gunshot joint injuries made up 8% of gunshot injuries to the extremities (13). Reports from the war in Afghanistan showed that out of a series of 756 injured persons, 20.3% sustained penetrating joint injuries without bone lesions. Shoulder injuries occurred in 33.7%, and wrist joint injuries in 9.2% of cases (14).

Injuries to the extremities inflicted by mines and explosives during the Vietnam and Arab-Israeli wars in 12.6% of cases resulted in the loss of the extremity, and in the Afghan army, in the period between 1984 and 1987, that percentage was between 30% and 45% (15). The latter war has also been called 'mine war' by some. Approximately, 20% of injuries were injuries to the upper extremities, and 64% were injuries to the lower extremities (16, 17).

Type I and II open fractures of the extremities react well to treatment, while type III wounds constitute a major problem with the incidence of infection in as many as 24% of cases (18, 19). Primary care is the prevention of infections in open fractures, especially in type III wounds, and that is why this type was divided into three sub-types. According to Gustillo classification, the incidence of infection in these three sub-types was as follows: 4% in sub-type IIIa, 52% in sub-type IIIb, 42% in sub-type IIIc, and the incidence of amputations was as follows: 0% in IIIa, 16% in III b, 62% in IIIc (20, 21).

The best way to prevent war wound infections, other than to perform radical surgical treatments, is to eliminate pockets and dead-spaces where collections of liquid-haematoma, which are an excellent ground for the growth of bacteria, accumulate (22). A large number of authors recommend war wound re-excision within 24-48 hours as it is difficult to accurately assess the vitality of tissue during the primary excision (23, 24). In his experimental research, Albreht found that by local admission of antibiotics three hours after sustaining injury, the primary surgical treatment of the wound may be postponed by up to 72 hours without increasing the prevalence of local infection. Jackson reached similar conclusions during the Falkland Islands War (25). He commenced with antibiotic therapy within a period of up to 6 hours. The results showed that there were no septic complications when the antibiotics were administe-

red up to three hours after sustaining the wound as they inhibit the growth of bacteria in gunshot wounds (25).

The International Committee of the Red Cross recommends administering crystalline penicillin, 5.000.000 units, intravenously every six hours on admission and continuing for minimum 48 hours; administering orally penicillin preparation 0.5 every 6 hours over the next six days.

The complications that we had in working with external fixators were as follows: 86 (5.46%) cases of pin tract infections, 3 (0.19%) pin breakages, 42 (2.66%) fixator re-assembly procedures, 6 (0.38%) iatrogenic vascular lesions inflicted with the drill or pin and 4 (0.25%) iatrogenic nerve lesions.

70% of gunshot injuries were localized on the extremities, and approximately 40% of these injuries were accompanied by fractures.

In the examined material, it was necessary to treat (primarily) muscle and cutaneous injuries to the extremities in 265 (10.77%) cases, and in 2.195 (89. 23%) cases bone fragments needed to be stabilized due to bone tissue injuries. Out of the 2.195 bone tissue injuries (bones), in 2.043 (92.43%) cases these were comminuted fractures with or without bone defects.

Karapetjev and Petrov presented their experiences in the treatment of 1.361 patients with gunshot fractures of the long bones in Angola. In 17 patients, bone defects were longer than 5 cm (2). The authors believe that they can perform, under antibiotic protection, internal osteosynthesis and autospongioplastic of gunshot fractures of the long bones 21 days after the primary surgical treatment (2). Out of the 1.361 gunshot fractures, Karapetjev and Petrov performed osteosynthesis in 71 patients within first 48 hours, in 88 after 3-6 days, in 659 after 7-10 days, in 39 after 10-29 days, and in 21 patients it was performed after 21 days (2). The same authors claim to have had good and satisfactory results in 113 (12.88%), and bed in 765 (87.12%) patients (2).

In 1988, Mussa published treatment results for 258 patients. The most frequent method of stabilization at the stage of primary surgical treatment was plaster splint in 26.4% of patients and definitive plaster cast with window in 58.1% of patients (2). Plate osteosynthesis at the stage of primary surgical treatment was performed in 1.2% of patients, delayed primary osteosynthesis in 0.4% of patients, and secondary in 2.7%. The external fixator in primary war surgery was applied in 2% of patients. 24.8% of patients had some infection, and 10.8% had pseudoarthrosis (2).

Based on the experience from the Afghanistan war, Gricanov *et al.* favour external fixators, pressing ahead with compression/distraction external fixators with hinged joints (7).

In 1994, Jovanović Z. *et al.* analyzed 820 gunshot fractures, of which number 670 (77.2%) patients were military members and 105 (12.8%) were civilian victims of war who sustained their injuries in the period between July 1991 and September 1992 (12). The injuries, divided by segments, were as follows: femur 213 (26%), tibia and fibula 324 (39.5%), foot 39 (4.8%), humerus 141 (17.2%), radius and ulna 103 (12.5%). 84 (10.2%) patients had multiple injuries and 37 (4.9%) of them had injuries to internal organs (12). The methods used for stabilizing fractures at the stage of primary surgical treatment were as follows: external fixator 447 (54.5%) times, plaster cast 279 (34.0%), skeletal traction 13 (1.6%), other methods 81 (9.7%) (12).

The speed at which a wounded person will be taken from the site of wounding to the surgical station is very important (13). In Vietnam, for example, the wounded were transported by helicopter to an aircraft carrier with utterly well equipped surgical station, so that the wounded were treated within 1-1.5 hours (13). In the examined material, the wounded were treated within 3 hours. A similar transportation method, with the lowest infection percentage (1.5-5%), was used in 1973 in the war between Israel and Egypt (13).

In the war, external fixation was for the first time used more frequently to treat open injuries to the extremities. In the period between September 15, 1991 and December 1, 1995, in 72% (1573 external fixators) of cases injuries were stabilized by external fixation, plaster cast and plaster cast in combination with Steinmann pins and Kirschner needles were used in 24% (531) of cases and extension procedures were used in 4% (91) cases (2).

In an AAOS (American Academy of Orthopedic Surgery) notification, the following are stated as the causative agents of chronic bone infection: Staphylococus aureus 84.2%, Escherichiae colli 3.2%, Klebsilla 2.9%, Streptococus B hemoliticus 2.3%, Pseudomonaes aeruginosa 2.0%, and all others make up 5% (25). The data that I. Gavrankapetanović from Sarajevo Orthopaedics and Traumatology Clinic presents while monitoring causative agents are interesting and they are as follows: Staphylococcus aureus occured in 36% of cases, Pseudomonas aeruginosa in 16% of cases, Seratia marcescens in 15% of cases, Proteus mirabilis in 5% of cases, and fatal Enterococcus fecalis in 3% of cases (6). On the basis of the antibiogram done on the fistula, the following infectious agents were found in our patients: Staphylococus aureus 31 (51.4%), Pseudomonas spp. 8 (13.8%), Pseudomonas aeruginosa 7 (12.5%), Enterobacteriaceae 3 (5.5%), other 5 (8.45%) (Stapphyloccocus epidermalis, Esecherichiaa colli, Streptococus B haemoliticus, Bacilus pyocineus, Klebsilla spp). 5 (8.4%) patients suffered from mixed infection: Pseudomonas aeruginosa + Enterobacteriaceae, Staphylococcus aureus + Enterobacteriaceae, Pseudomonas aeruginosa + Klebsiella spp (1).

There were 5 (0.2%) cases of gas gangrene in the examined material. Re-interventions were performed and 491 (69.73%) of them following primary treatment of the wound, where stabilization was done by plaster cast,

or with the combination of plaster cast and Steinmann pins, Kirschner needles or with extensions. The reasons for performing re-interventions were as follows: change of plaster cast because it was soaked with blood, plaster cast maceration, inadequate position of bone fragments and secondary infection of the war wound (1).

In 1976, Böhm and Könn described morphological changes in chronic post - traumatic osteomyelitis on the basis of 760 cases of egzogenous osteomyelitis. Aggressive chronic osteomyelitis with characteristic histological finding, showing purulent inflammation lined with fibrous wall and granulation tissue, and chronic (persistent) osteomyelitis characterized by connective tissue rich in cells and capillaries, and cell infiltration for the purpose of bone formation (8, 9).

There were infections of muscle and cutaneous tissue, acute osteomyelitis, where re-interventions were performed in 704 (28.59%) wounded persons. Despite the surgical and drug therapies, chronic osteomyelitis occurred in 74 (2.92%) cases, classified by bones as follows: humerus 7, radius 4, ulna 5, femur 21, tibia 31, calcaneus 3, metatarsal bone 1.

In 1994, Jovanović Z., Popović Z. *et al.* presented the criterion for handling bone defects of the long bones by the bone auto-transplant and stabilization of bone fragments by the AO compression plate. They describe their experience of treating 129 diaphisary gunshot fractures. The requirements for using this method are as follows: good soft-tissue cover, absence of clinical and laboratory signs of infection and bone defects not exceeding 4 cm (2).

Ardashov describes a series of 32 upper arms after gunshot fractures. He performed closed compression osteosynthesis by the Ilizarov method in 15 upper arms where the contact was achieved between fragments, with minimum 2/3 of the diaphyseal cross-section (11). Corticotomy was performed and the Ilizarov distraction osteogenesis method was used in 11 cases, and in 6 cases he used the AO compression plate for stabilizing the fragments. He obtained good results in 23 (72%) patients - achieved bone consolidation (11). In 7 (22%) patients the results were satisfactory, and in 2 (6%) patients healing did not occur.

CONCLUSION

The experiences gained during the war and the results achieved justify the attitude that the method of choice for primary stabilization of bone fragments in war wounds is - EXTERNAL FIXATOR.

Having experience with a large number of fixators, I have realized that the best external fixator is the one closest to W. Roux's maximum-minimum law and Wolff's law of transformation. Translated to the external fixator, this would mean that the best external fixator is the one that provides maximum functions (combinations) with minimum material and enables, through healing stages and by transforming the outer frame, the stabilization of bone defects with and without bone fragments, bone distraction, biocompression, and elastic fixation.

A war fixator should be easy to manufacture and user-friendly for doctors who have never performed external fixation.

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ZNAČAJ SPOLJNE FIKSACIJE PRI PRIMARNOM ZBRINJAVANJU RATNE RANE EKSTREMITETA

Predrag Grubor[1], Milan Grubor[2], Ivan Golubović[1], Predrag Stojiljković[1], Zoran Golubović[1,3]

[1]Ortopedsko-traumatološka klinika Banja Luka, Republika Srpska, Bosna i Hercegovina
[2]Medicinski fakultet Banja Luka, Republika Srpska, Bosna i Hercegovina
[3]Univerzitet u Nišu, Medicinski fakultet, Srbija

Sažetak

Ratna rana je oštećenje organizma, naneseno vatrenim oružjem, velike kinetičke energije (blast, projektil, opekotina) nastala u ratu. Karakteriše se obilnim razaranjem, primarnom kontaminacijom i izmjenjenom reaktivnošću organizma.

U ovoj retrospektivnoj studiji prikazuje se način primarnog zbrinjavanja povređenih ekstremiteta, sa i bez preloma, kao i izbor metode za stabilizaciju polomljenih kostiju.

U ovoj studiji se analiziraju 2462 ranjenika sa povredama: ekstremiteta, abdomena, toraksa i glave, koji su po ranjavanju primarno hirurški zbrinuti na Ortopedsko-traumatološkoj klinici u Banja Luci, u periodu od 15. septembra 1991. godine do 1. decembra 1995. godine. Od 2462 ranjenika, 122 (4.59%) povrijeđenih su bile žene, 24 (0.9%) dijece i 2269 (94.15%) muškarci. Prosječna životna dob ranjenih je 33.73 godine. Kod 265 (10.77%) bilo je povreda ekstremiteta muskulo-kutane prirode, bez preloma kosti, a 2197 (89.23%) ranjenika imalo je slomljene koštane fragmente, koje je poslije primarne hirurške obrade trebalo stabilizovati. Od 2197 ranjenih koji su imali slomljene kosti, kod 2043 (92.43%) bili su kominutivni prelomi sa ili bez koštanog defekta. 1573 (72%) polomljenih koštanih fragmenata je primarno stabilizovano spoljnjim fiksatorom, 531 (24%) gipsom i gipsom u kombinaciji sa Steinmann-ovim klinovima i Kirschner-ovim iglama a kod 91 (4%) smo koristili ekstenziju.

Komplikacije koje smo imali pri radu sa spoljnjim fiksatorom bile su: infekcija oko klinova 86 (5.46%), lom klina 3 (0.19%), premontiranje fiksatora zbog primarnog neadekvatnog postavljanja spoljnjeg fiksatora kod 42 (2.66%), vaskularne jatrogene lezije nanesene bušilicom ili klinom 6 (0.38%) i jatrogene neurološke lezije 4 (0.25%).

Složenost, specifičnost i originalnost svake ratne rane zahtijevaju stručnost, iskustvo, pažnju i studioznost. Svaki bolesnik je poseban entitet i traži aktivan stav u toku cijelog liječenja.

Iskustva stečena u poslednjem ratu (radeći sa 28 tipova spoljnjih fiksatora) i postignuti rezultati daju mi pravo da tvrdim da je metoda izbora za primarnu stabilizaciju koštanih fragmenta kod ratne rane spoljnja fiksacija po Mitkoviću M20.

Ključne riječi: **spoljni fiksator po Mitkoviću M20**