

## Comparative results in the treatment of clavicle fractures

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### Abstract

**Background:** The negative results of the clavicle fractures treatment represent a high percentage, which implies the search of new methods designed to improve these results. Thus, a new method of stable and functional osteosynthesis of the clavicle fractures were proposed for this improvement, namely that performed with the external fixator. In connection with this, a comparative analysis of the results between the stability and efficacy of osteosynthesis of the clavicle fractures by using the external fixator proposed by us and the traditional methods was conducted.

**Material and methods:** For a better deduction and evaluation of the clavicle fractures treatment methods, it was established a task based on a clinical-radiological examination at 124 patients with clavicle fracture, which constitutes 2.7% of the number of patients hospitalized with skeletal fractures. Thus, for better surgical treatment results of clavicle fractures at the patients, was introduced a new stable and functional osteosynthesis method of the clavicle fracture treatment with an external fixator.

**Results:** The application of the stable-functional osteosynthesis method of the clavicle fractures with an external fixator's help succeeded in a reduction of the medium – term work incapacity, the quantity of mistakes and complications reduction and the considerable increase of the positive results of the treatment, while not neglecting the economic aspect on the background of the shortcomings exclusion of traditional surgical methods.

**Conclusions:** The stable and functional osteosynthesis method of the clavicle fractures treatment with an external fixator versus the traditional treatment methods ensures the possibility of early functional treatment, also reducing the average of work incapacity term, mistakes and complications appeared as consequences of traditional treatment methods application and offers the possibility to use it at all specialized surgical care levels.

**Key words:** osteosynthesis, external fixator, clavicular fracture.

### Introduction

The main factor in each treatment method of clavicular fracture is not only getting the fractured fragments consolidation but also getting an early, complete functional rehabilitation and the reduction of the work disability term [1, 2, 5, 6, 7, 10, 11]. The fact, that in the surgical treatment of the patients with clavicular fractures are proposed different methods, confirms the existence of multiplicity difficulties faced by trauma surgeons [3, 4, 8, 9,12,13,14], both in identification of the method and its performance, coming out from the inventory of technical resources [15, 16, 17, 18, 20, 25, 26].

Until now, the most spread out method of treatment of a clavicular fracture is the intramedullary osteosyntheses realized with a stainless steel rod made by following the Bogdanov's example (IXI8H9T mark) with the length of 125 mm and 3.5 thickness and on brooches from stainless steel (IXI8H9T mark) made after Kirschner and Elizarov's example with the diameter of 1.8 and 2.2 mm which are not providing a stable fixation of the fragments and require a stable external immobilisation [21, 22, 23, 24, 27, 28]. Therefore, this kind of a method excludes the possibility of an earlier functional treatment. The drawbacks of the traditional methods of described surgical treatment using intraosseous fixators, increase the percentage of complications and poor results.

### Objectives

1. Elaboration of a new osteosynthesis method of clavicular fragments fixed with an external fixator, simple in the way of the assembly and manufacturing, which will exclude the shortcomings of traditional methods of surgical treatment and its application to any level of specialized surgical aid.

2. Application of the developed method by the stable-functional surgical treatment of clavicular fracture in the clinic and determining the indications and contraindications on its utilization.

3. Obtaining a reduction of the time limits of incapacity for work, the number of errors and complications and increasing the percentage of the good results, using the proposed new method of treatment.

4. The study and comparison of the results of an early treatment and on time distance, of the period of work incapacity, of the mistakes and complications at the patients treated by applying the new method of stable-functional osteosynthesis, in comparison with the results of treatment through the traditional surgical methods.

### Analysis and comparison

The analysis of observations of surgical treatment using traditional methods has been made on 61 patients. Typically, surgical treatment is applied after orthopedic ineffective reduction (59%).

Therefore, as indications for applying the surgical intervention have served the displacements on the longitudinal radius fragments larger than the diameter of the bone.

The term of work disability of the patients treated according to traditional methods accounted 72.7-24.5 days. At the patients, who in the postoperative period never had complications, the term of work incapacity amounted to 58-17.2 days; at the patients, to whom the complications emerged during the postoperative period, it grew up to 81.3-12.5 days. After performing the intraosseous and combined osteosynthesis for the fixator removing, it is required a surgical reintervention. According to our calculations, the period of work incapacity after removing the fixator constituted 6.6-3.0 days, a total of 79.3-27.5 days.

Throughout the surgical treatment, according to traditional methods, surgical errors and complications were detected at the 21 patients (34.7%). A total of 28 were identified for complications. The most common, from 21.4 percent of the total number of complications, have been: migrating rod; skin perforation; slower consolidations; pseud-arthritis – 14.2%.

Examination of the mistakes and complications confirmed that the main factor that led to their appearance was the multi-traumatic surgical intervention and the instability of the osteosynthesis that have influenced negatively the outcome of the treatment, therefore, the "unsatisfactory" results amounted to 14%.

Results over time of the treatment with traditional surgical methods were examined at 50 (81.8%) patients. According to our calculations, excellent analysis results were obtained from 21 (42.8%) patients, good – 14 (28.0%) patients, satisfactory at – 8 (16.0%) patients and unsatisfactory – 7 (14.0%) patients.

In this context, the unsatisfactory results, obtained by us on the basis of clavicular fractures treatment observations with traditional surgical methods, require new methods of innovation of a less traumatic osteosynthesis that would:

- Ensure a stable fixation of fragments without applying an external immobilization;
- Retain the full function in the joints of upper limb involved in trauma;
- Shorten the period of incapacity for work and the number of errors and quantitative complications;
- Improve the results of treatment;
- Give the option of completing treatment at any level of aid.

### **The advantages and effectiveness of the external fixator using**

In the view of these reasons, the surgical treatment performance at the patients with clavicular fractures is trivial.

The development of a simple and reliable method of treatment of the clavicular fractures, less traumatic, which would provide the opportunity to carry out them at any level of specialized surgical aid, in our view, is timely and actual.

These assumptions have formed the idea of the innovation of an external fixator (innovation certificate No 2784 RM), as well as the elaboration of new methods of osteo-

synthesis using it (certificate of innovation No 2785 RM) in different variants (innovation certificate No 2809 RM).

In order to provide the effectiveness research of the use of the external fixator and mechanical force of fragments characteristic for the fixator, was evaluated through experimental samples, the comparability of mechanical fixation force of the fragments by using the proposed fixator and the mechanical fixation force of the fragments by traditional methods application of surgical treatment – the rod made by Bogdanov's example and two brooches made by Kirschner and Elizarov's example.

The innovated method of osteosynthesis of clavicular fragments and their fixation with external proposed fixator has been applied in clinical conditions on 63 patients. In the process of applying in clinic, we used 2 variants of the osteosynthesis method. For each variant have been developed specialized indications.

The application of osteosynthesis method of the external fixator assembled in the first version underwent 51 patients, in the second variant – 12 patients. The average time of the fragments fixation with external fixator was 35.3+-3.38 days. The mean time of work incapacity amounted to 46.2+-5.7 days.

In the process of applying the proposed external fixator in clinic were discovered mistakes and complications at 7 (11.4%) patients. It is appropriate to mention that mistakes and complications were common during the method learning in clinic and influenced essentially the outcome of the treatment at 3 (4.74%) patients.

The overtime results were examined by us at 57 (93.6%) patients. Excellent results were obtained at 48 (81.39%), good – 8 (13.59%), satisfactory – 2 (3.2%) patients, unsatisfactory at one sick person (1.6%). The obtained results as a consequence of surgical treatment with the help of the application in clinic of the osteosynthesis method with external fixator mounting, confirm the efficacy of the developed method by obtaining excellent and good results at the 56 (94.98%) patients.

The medium-term work incapacity at the patients treated by surgical implants and osteosynthesis method of the fragments, developed by us and fixed with external proposed fixator, compared to traditional surgical methods (osteosynthesis with Bogdanov's rod, Kirschner's 2 brooches, combined) has been reduced by 1.76 times ( $P < 0.01$ ).

The mistakes and complications detected in the treatment of clavicular fractures according to the method developed by us, in comparison with mistakes and complications detected in the treatment of patients after surgical traditional treatment, have been three times reduced.

The comparison of overtime results, confirms high percentage of excellent and good results of 24.98% versus percentage of excellent and good results in treating patients by traditional surgical methods, which are relative one to another 1.5:1 ( $P < 0.01$ ), to the application of traditional methods in terms of 6.5:1 ( $P < 0,05$ ) when using the method developed by us.

Therefore, the average of the hospital stay of patients treated by the utilization of the developed method was re-

duced by 1.4 times ( $P < 0.001$ ), and the medium-term work disability by 1.8 times ( $P < 0.01$ ).

In this context, taking into account, that the new treatment method ensures reduction of work incapacity term, the reduction of the number of mistakes and complications, substantial improvement of the treatment results, the economical effect increase and the exclusion of the shortcomings of traditional surgical methods, the innovative method can be recommended as an alternative method of treatment of clavicle fractures in trauma practice at any surgical specialized aid level.

### Conclusions

The research of literary sources has justified the assumptions of some authors, who used the surgical transosseous method with their external fixation for the osteosynthesis of the fragments.

Therefore, the method is less traumatic, but technically difficult to fulfill, which is possible only in conditions of specialized institutions and clinics in Traumatology and Orthopedics, properly equipped and with highly qualified specialists on the staff.

The developed osteosynthesis stable-functional method of clavicular fractures provides the obtaining of a solid fixation of the fragments with different characters and offers the possibility of early functional therapy.

The application of the osteosynthesis stable-functional method in clinic and its variants, according to developed indications for them at 63 patients allowed obtaining excellent and good results in 94.96% of cases.

Reduction in the number of mistakes and complications by three times, reduction of hospitalization term of patients by 1.4 times and reduction of the period of work incapacity by 1.8 times confirms the essential priority of the proposed osteosynthesis stable-functional method and may be recommended as an alternative method of treatment of clavicle fractures at all levels of specialized surgical aid.

### References

1. Evdokimov MM. Lechenie perelomov kliuchitsy [Treatment of clavicle fractures]. Med Ref Zh (Saratov). 1985;(4):64. Russian.
2. Sviridov AI. Primenenie kompresii i chrezkostnoi fiksatsii pri lechenii perelomov kliuchitsy u detei starshego vozrasta i podrostkov [The use of compression and transosseous fixation in the treatment of clavicle fractures at older children and adolescents]. In: Trudy Voronezhskogo Meditsinskogo Instituta. T. 97 [Scientific papers of the Voronezh Medical Institute. Vol. 97]. 1976. p. 23-27. Russian.
3. Fil'ke Kh. Osteosintez kliuchitsy s pomoshch'iu naruzhnykh fiksatorov kak al'ternativa konservirovannogo lecheniia [Osteosynthesis of the clavicle with the help of external fixators as an alternative to preserved treatment]. Unfallchirurg (Germany). 1989;(6):302-303.
4. Canadian Orthopaedic Trauma Society. Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures: a multicenter, randomized clinical trial. J Bone Joint Surg Am. 2007 Jan;89(1):1-10.
5. Chu CM, Wang SJ, Lin LC. Fixation of mid-third clavicular fractures with Knowles pins: 78 patients followed for 2-7 years. Acta Orthop Scand. 2002 Apr;73(2):134-9.
6. Charity RM, Haidar SG, Ghosh S, Tillu AB. Fixation failure of the clavicular hook plate: a report of three cases. J Orthop Surg (Hong Kong). 2006 Dec;14(3):333-5.
7. Sviridov AI. Primenenie chrezkostnogo osteosinteza u bol'nykh s perelomami kliuchitsy [The use of transosseous osteosynthesis at patients with clavicle fractures] [dissertation]. Kharkov: [Kharkov M.I. Sitenko Scientific Research Institute of Orthopedics and Traumatology]; 1981. 198 p. Russia.
8. Zenni EJ Jr, Krieg JK, Rosen MJ. Open reduction and internal fixation of clavicular fractures after 10 year monitoring. J Bone Joint Surg Am. 1991;89(2):118-121.
9. Marti RK, Nolte PA, Kerkhoffs GM, Besselaar PP, Schaap GR. Operative treatment of mid-shaft clavicular nonunion. Int Orthop. 2003;27(3):131-135.
10. Durak K, Sariozen B, Ozturk C. Results of conservative treatment of midclavicular fractures. Ulus Travma Derg. 2002 Oct;8(4):229-32.
11. Fuch M, Losch A, Sturmer KM. Surgical treatment of the clavicle - indication, surgical technique and results. Zentralbl Chir. 2002 Jun;127(6):479-84.
12. Tomodia Ch, Basin B, Socol T, et al. Indications et resultats dans le traitement chirurgical des fractures claviculaires [Indications and results in the surgical treatment of clavicular fractures]. In: AOLFCongress Materials. Bucharest; 2002. p. 132-133. French.
13. Martel II, Darvin EO. Resultats du traitement des fractures fermées de la clavicle par méthode de l'ostéosynthèse transosseuse [Treatment results of closed clavicle fractures by transosseous osteosynthesis]. In: 13th AOLFCongress, 7th SOSECOT Congress; 2012 Jan; Dakar, Senegal. [CD-ROM]. French.
14. Grassi FA, Tajana VS, D'Angelo F. Management of midclavicular fractures: comparison between nonoperative treatment and open intramedullary fixation in 80 patients. J Trauma. 2001;50(6):1096-1100.
15. Mizue F, Shirai Y, Ito H. Surgical treatment of comminuted fractures of the distal clavicle using Wolter clavicular plates. J Nippon Med Sch. 2000;67(1):32-34.
16. Jubel A, Andermahr J, Weisshaar G, Schiffer G, Prokop A, Rehm KE. [Intramedullary nailing (ESIN) in clavicular pseudoarthroses. Results of a prospective clinical trial]. Unfallchirurg. 2005 Jun;108(7):544-50. German.
17. Mikkel'sen G. Novoe ustroistvo dlia naruzhnoi fiksatsii [New device for external fixation]. Acta Orthop Scand (Denmark). 1990;59:708-715. Russian.
18. Nazarov EA. O funktsional'nom lechenii perelomov kliuchitsy [About the functional treatment of clavicle fractures]. Ortop Travmatol Protez. 1982;(7):50-51. Russian.
19. Oleksiuk DI, Pelipchenko VP. Migratsiia fiksatorov v sredostenie i pozvonochnike posle metallicheskogo osteosinteza sternal'nogo kontsa kliuchitsy [Migration of the fixators in the mediastinum and the spine after metal osteosynthesis of the sternal end of the clavicle]. Med Ref Zh. 1984;(11). Russian.
20. Neviasser RJ, Neviasser JS, Neviasser TJ, Neviasser JS. A simple technique for internal fixation of the clavicle. Clin Orthop Relat Res. 1975;109:103-107.
21. O'Rourke IC, Middleton RW. The place and efficacy of operative management of fractured clavicle. Injury. 1975;6(3):236-240.
22. Politano B, Jucopilla N, Gherardi GM, Loda M, Pelesi A, Uggery M. Riduzione cruenta della frattura di clavicola [Complete reduction of clavicle fracture]. Minerva Ortop. 1980;31(12):641-646. Italian.
23. Pyper JB. Non-union of fractures of the clavicle. Injury. 1978;9(4):268-270.
24. Zenni EJ Jr, Krieg JK, Rosen MJ. Open reduction and internal fixation of clavicular fractures. J Bone Joint Surg Am. 1981;63(1):147-151.
25. Zenni EJ Jr. The results of open reduction and internal fixation of clavicular fractures. J Bone Joint Surg Am. 1985;72(3):243-248.
26. Wahl D. Probleme der operativen Behandlung von Schlüsselbeinbrüchen [Problems of surgical treatment of fractured collarbone]. Zentralbl Chir. 1974;99(27):858-859. German.
27. Tischer W. Indikationen und Gefahren der Osteosynthese im Kindesalter [Indications and dangers of osteosynthesis in childhood]. Zentralbl Chir. 1976;101(3):129-139. German.
28. Vanganess CTh, Carter DR, Frankel VH. In vitro evaluation of the loosening characteristics of self-tapped and non-self-tapped cortical bone screws. Clin Orthop Relat Res. 1981;157:279-286.