Clinical Aspects of The Use of Smooth and Full-Threaded Rods of The VOSIS Veterinary Orthopedic Set in Cats

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Abstract*: *The article presents the results of using the smooth and full-threaded rods of different diameters in the treatment of limb fractures in cats in hardware structures made from parts of the VOSIS veterinary orthopedic set. A total of 22 cats have participated in the studies, which were divided into two groups according to the type of rods installed during the surgery: smooth rods were installed in the cats of the first group, and full-threaded rods – in the cats of the second group. The work was aimed at conducting a comparative clinical study of using the smooth and full-threaded rods of different diameters in the treatment of fractures of various limb segments in cats. It has been shown that all cats that had undergone surgery successfully passed the postsurgical period. It has been revealed that the use of full-threaded rods provides higher stability of instrument structures. It has been established that the presence of flows at the full-threaded rods' emergence points in the studied groups was less pronounced than in groups where smooth rods had been used.

Index Terms*: *cats, full-threaded rods, instrument structures, smooth rods, unstable surgical fixation, veterinary orthopedic set.

I. INTRODUCTION

Nowadays, the issue of treatment of long bone fractures in cats remains open, especially in the urban environment. This was repeatedly discussed at various domestic and international seminars and conferences of veterinarians (2003, 2007, 2009, 2010, 2012 and 2013), to which a large number of publications was devoted [1-3].

Modern veterinary surgery uses the most traditional methods of conservative and surgical treatment of animals with congenital and acquired orthopedic and trauma pathology of the bones of the axial and peripheral skeleton.

The transosseous osteosynthesis method, developed by academician G.A. Ilizarov (1951), allowed to create conditions of biological and mechanical nature necessary for a favorable course of reparative processes in damaged bone tissues and, thus, gave life to a qualitatively new scientific and practical direction in world traumatology and orthopedics [4-6].

In veterinary practice the implementation of this method started in the 90-ies of the 20th century, facilitated by significantly increased demand in the provision of specialized care to small pets with injuries of the musculoskeletal system. Injuries among animals are widespread, with fractures of the limbs occurring in 44.5 % of the cases [4, 7, 8.

Currently, traditional conservative (gypsum dressings, splints) and operative (the extrabone and intrabone clamps) bone immobilization methods are used to treat diaphyseal fractures of the long tubular bones of the limbs of small pets, particularly cats [9-11]. The instrumentation structures based on the principle of connecting transosseous rods and wires using various polymer adhesive bases (for example, POXIPOL) are also used, which does not always provide accurate reposition and rigid stable fixation of bone fragments throughout the entire treatment period [12, 13].

Using the method of G. A. Ilizarov and similar methods by other authors for bone fractures of various etiologies, severity and localization made it possible to create conditions for a favorable course of reparative osteogenesis and to obtain positive anatomical and functional treatment results.

However, these technical and technological possibilities of treatment for limb bone fractures in small domestic animals in some cases do not justify themselves and require the development of other methods of osteosynthesis, structural systems and technologies [14, 15].

For adapted use in osteosynthesis, monolateral devices (Kirchner spokes) are the most practical ones, but their repositioning properties for small domestic animals are limited and not always successful [16, 17].

In recent decades, the intraosseous osteosynthesis has been introduced into the veterinary practice according to the method of G. A. Ilizarov, which has shown its effectiveness not only in experimental but also in clinical direction.

In the world literature, there is evidence of the successful application of the G. A. Ilizarov method in small domestic animals in the treatment of distal extremities (lower leg, forearm), as well as separate publications on the application of this method in the treatment of proximal parts of the shoulder and hip bones. At the same time, the

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methods used are not supported constructively, and the proposed instrumentation structures are not multipurpose in the application.

According to numerous studies, the regenerative processes in the damaged bone depend on the state of osteogenic tissues and the blood supply to the injured area and their maximum preservation, which contributes to the bone restoration in earlier periods [18, 19].

Accurate reposition of bone fragments and their stable fixation throughout the entire period of treatment with preservation of the function of adjacent joints and the limb as a whole are important conditions for a favorable course of osteogenesis [20-21].

Objectives of the study. The study was aimed at achieving the maximum clinical effect (bone healing, normal limb operation) in the treatment of various types of bone fractures in cats with a wide variation in body size and weight, using external osteosynthesis performed by means of the VOSIS veterinary orthopedic set.

The VOSIS veterinary orthopedic set [1] is intended for the implementation of external (instrumentation) and internal (extrabone) osteosynthesis in domestic animals weighing 0.2 to 85 kg. The set is equipped with radius and straight plates, support beams, rods, wires, finger-type special fixators, multipurpose monoblock units [22-24], as well as a nut-bolt fastener. The set contains smooth rods from 0.8 to 5.0 mm, solid-threaded rods M2.0, M2.5, M3.0, M4.0, M5.0, and rods with deep cutting of 4.0 – 5.0 mm. All rods in the set have two types of sharpening: pen-type and sickle-shaped [25, 26], are made of stainless steel and suitable for medical use.

The work was aimed at conducting a comparative clinical study of the use of smooth and full-threaded rods of different diameters in the treatment of limb fractures in cats in hardware structures made from parts of the VOSIS veterinary orthopedic set. The study analyzed the stability of external structures and assessed the stability of fixing smooth and full-threaded rods when dismantling instrumentation structures, and also evaluated the biomechanical interconnection [27, 28] of the contact area of the used rods with the skin during the dismantling of instrumentation structures.

II. MATERIALS AND METHODS

The studies were performed in 2016 – 2018 on the basis of the BION veterinary complex (Sevastopol) and the Department of Anatomy, Veterinary Obstetrics and Surgery of the FSBEI HE Kuban SAU (Krasnodar). In animals (cats), fractures of various bones of the peripheral skeleton were treated. All animals were operated within 3 – 4 hours to 2 days after the occurrence of fractures [29]. All surgeries were performed as per the closed type [30] (without surgical access to the fracture site). A total of 22 cats undergone surgery. Fractures in the studied animals were distributed as follows (Table 1):

Table 1. Distribution of fractures in cats

Diagnosis	Amount	Percent
Fracture of the humerus	8	36.36 %
Fracture of both forearm bones	1	4.54 %
Femur fracture	10	45.45 %
Fracture of the lower leg bones	3	13.63 %
Total	22	100 %

For research, the cats were divided into two groups: in the animals of the first group the instrument structures with smooth rods were installed; in the cats of the second group – those with full-threaded rods. The rods were screwed in using a cordless drill with varying speeds of 100 ÷ 500 rpm for smooth rods, and 50 ÷ 250 rpm for full-threaded rods [31]. The introduction of whole-threaded rods, regardless of their diameter, did not require any specialized devices [32]. The whole-threaded rods were introduced with less physical effort than smooth rods when introduced into similar bone areas [33]. The terms of healing of fractures in group I of cats varied from 22 to 28 days. In group II, the periods varied from 18 to 25 days.

III. DISCUSSION AND RESULTS

The results of using the rods with a smooth and whole-threaded surface for bone fractures in cats in both groups are presented in Table 2.

Table 2. The use of the rods with a smooth and full-threaded surface for bone fractures in cats

Indicator	Fracture				Total
	humerus	forearm bones	femur	lower leg bones	
First group					
Number of cats, units %	4 30.76	1 7.69	6 46.15	2 15.38	13 100
Number of installed rods, %	17 27.86 %	4 6.55	31 50.81	9 14.75	61 100
Second group					
Number of cats, units %	4 44.44	0	4 44.44	1 11.11	9 100
Number of installed rods, %	19 44.18	0	19 44.18	5 11.62	43 100

The results of the distribution of unstable and stable instrument structures using rods of both types are presented in Table 3.

Table 3. Distribution of unstable and stable hardware structures, as well as the distribution of loosened and tightly fitted rods in cats

Fracture							
humerus		femur		forearm bones		lower leg bones	
Unstable instrument structures (smooth rods)							
2 (50 %)		3 (50 %)		-		-	
Loosened (l) and tightly-fitted (t) smooth rods							
8^{l} (47.05 %)	1^{t} (5.88)	14^{l} (45.16 %)	2^{t} (6.54 %)	-		-	
Unstable instrument structures (smooth rods)							
2 (50 %)		3 (50 %)		1 (100 %)		2 (100 %)	
Loosened (l) and tightly-fitted (t) smooth rods							
2^{l} (11.76 %)	6^{t} (35.9 %)	4^{l} (12.9 %)	11^{t} (35.48 %)	-	4^{t} (100 %)	-	9^{t} (100 %)
Instability of instrument structures (full-threaded rods)							
1 (25 %)		1 (25 %)		-		-	
Loosened (^{l}) and tightly-fitted (^{t}) full-threaded rods							
5^{l} (26.31 %)	-	4^{l} (21.05 %)	-	-		-	
Stability of instrument structures (full-threaded rods)							
3 (75 %)		3 (75 %)		-		1 (100 %)	
Loosened (^{l}) and tightly-fitted (^{t}) full-threaded rods							
3^{l} (15.64 %)	11^{t} (57.89 %)	3^{l} (15.78 %)	13^{t} (63.15 %)	-		-	5^{t} (100 %)

When analyzing the data in Table 3, it should be noted that in the first group of cats, the number of loosened and stable structures was the same – 50 % each for fractures of the humerus and femur. With fractures of the forearm and lower leg, in 100 % of cases, the instrument structures with smooth rods were stable. When using full-threaded rods, the number of unstable and stable instrument structures for fractures of the humerus was 1:3. With leg fractures, the structure was stable.

It is important to note that the number of loosened rods with unstable apparatus with smooth rods on the humerus was 47.05 %, on the femur – 45.61 %, with unstable structures using full-threaded rods – 26.31 % and 21.05 %, respectively. At the same time, in the cases of unstable structures with smooth rods on the humeral and femoral bones, a tight fit of the rods was 5.8 % and 6.54 %, respectively. In loosened structures with full-threaded rods, tight-fitted rods were not observed.

It has been found that in the case of stable structures using smooth rods, the loosened rods of 11.76 % (humerus) and 12.9 % (femur) were present. In stable structures using full-threaded rods, the latter were loosened by 15.64 % (humerus) and 15.78 % (femur). Tightly-fitted smooth rods in stable structures amounted to 35.9 % (humerus) and 35.48 % (femur). Tightly-fitted full-threaded rods in stable structures amounted to 57.89 % (humerus) and 63.15 % (femur). In small examples of the forearm and lower leg fractures, in all cases, the stability of the structures and the tight fit of the rods were noted.

It should be noted that with loosened instrument structures, in the places where both 2.0 and 2.5 mm smooth, as well as M2.0, M2.5 full-threaded rods exited, the abundant secretion of sero-mucous nature was observed in cats. The scar tissue framing the rods was swollen and friable. In the cases of stable instruments, but with loosened rods of both types, the secretion was in the form of crusts, after removal of which, loose friable scar tissue was exposed. If the rods were tightly fitted, skin reddening was noted for all types with tight scarring of the wound edges. Secretion from the rod exit zone was negligible or completely absent.

IV. CONCLUSION

The studies have shown that all cats that had undergone surgery have successfully passed the postsurgical period. It has been revealed that the use of full-threaded rods provides higher stability of instrument structures. It has been established that the presence of flows at the full-threaded rods' emergence points in the studied groups was less pronounced than in groups where smooth rods had been used. Scar tissue was present at the exit points of all rods.

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