REVIEW ARTICLE

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# A Short Story of Veterinary Orthopedic Surgery

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**Abstract**
Looking at the historical development of orthopedic medicine, the story of the pioneers in this field emerging implant and implantation techniques with the general progress of general medicine is seen. These people have described very successful and permanent mainstream methods for the treatment of bone fractures, which have been a problem since ancient times. This article briefly describes the pioneers of orthopedics from past to present and the development of orthopedics in veterinary medicine.

**Keywords:** Implantation, orthopedic surgery, bone fractures.

## INTRODUCTION

Patients coming to a physician in a Veterinary Clinic with orthopaedic problems, have a significant ratio in the whole patient number. The most common problems are trauma related fractures, arthritis in different species and the neoplastic disorders located in the locomotor system.

Orthopaedics is a branch of medicine which can usually detect the problems the patients are going through easily and precisely. Clinical declaration of the orthopaedic problems is abnormal patterns of walk, or in a more straight-out manner, limping in various types and degrees accompanied by unwillingness towards movement and exercise along with pain. Early diagnosis of the problems has a big importance especially in arthritis and- neoplastic diseases.

We can see the orthopaedic problems in the early historical registries. For example there are skeletal deformities in ancient Egypt registrations. In addition, splints made of bamboos, different trees or horns were also found on some mummies. There are detailed treatment procedures for luxations of the knees, shoulders and hips in the ancient Greek documents written by Hippocrates himself (Francis, 1891). In the rising age of the Roman Empire, Galen of Pergamon (129-199 BC) has generated some basic terms of orthopaedics and traumatology which were considered as the main standards until the middle age (Brian, 1977).


**Figure 1.** This document is a papyrus describing veterinary practices in ancient Egypt

Turning of orthopaedics to be a medical and scientific discipline is dated to the middle of the 18th century. Nicolas Andry, a French physician, has used the term "*Orthopédie"* in his book, which was written for relatives of the patients rather than doctors, where he defines the deformities and treatment methods in children through illustrations (Bois-Regard, 1741). This is why Andry is considered as the eponym of this discipline. In fact, two more alternatives came to life at the period.

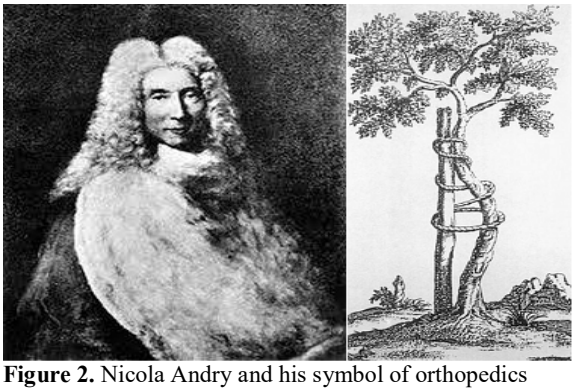

**Figure 2.** Nicola Andry and his symbol of orthopedics

The word orthopaedics comes from the Latin words orthos (straight) and pedios (child), and also traumatology is also originated in Latin and is used for the discipline of wounding and injuries (Kirkup, 1991) Orthopaedics aim to acquire straight and healthy livings which got rid of locomotor system disorders; whereas traumatology aims the injured/wounded elements of the locomotor system to regain their functions and to save the injured being's life.

The main concern in the veterinary medicine has always been *horses* until the industrial revolution in the 20's. Veterinarians have always been vastly interested in horse health. One of the two main causes of this approach was the fact that horses were the main source of the force needed in agriculture before mechanisation and the biggest force of the cavalry troops. Of course the orthopaedics has a great place in equine medicine, the saying "the horse means the foot" is the simplest way to state this. After the industrial revolution, the society started to turn into an industrial form and when this process finalized, people have found themselves in the cities, isolated and lonely. In terms of not breaking the whole bond between them and the nature and not getting so lonely, the number of people who adopt small animals such as cats and dogs has increased significantly, and the animals started to have a moral value. Starting with this point, the small animal medicine has become the fastest growing and the biggest segment of veterinary medicine. Naturally, this caused the veterinarians to make deep investigations in this field and take the health problems of cats and dogs into consideration deeply. The approach which used to be more "conservative" then has turned into a more "manipulative" one in the aspect of orthopaedics.In small animal practice, fracture fixation was far from being an exciting a discipline in the early 20th century. Muller's book -Diseases Of The Dog And Their Treatment- was translated to English and revised to a certain extent by Alexander Glass (Muller, 1897). This source was the most valid reference back then. There were only 7 pages in which the locomotor system diseases and only 4 in which fracture fixation were mentioned.

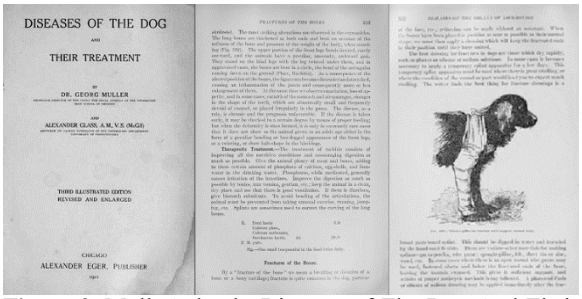
DISEASES OF THE DOG
AND
THEIR TREATMENT
BY
DR. GEORG MULLER
AND
ALEXANDER GLASS, A.M., V.S. (McGILL)
THIRD ILLUSTRATED EDITION
REVISED AND ENLARGED
CHICAGO
ALEXANDER EGER, PUBLISHER

**Figure 3.** Muller's book -Diseases of The Dog And Their Treatment

Perrin, who is a small animal practitioner in the state of Nebraska, stated that dogs were not worth of any financial or moral value for their owners and people believed that they should unload them especially when a fracture forms (Perrin, 1923). This insignificance of the dogs had only one exception and that was the Greyhound-Airdale mix breed which was used against coyotes in the farms. Perrin recorded that cage rest combined with the local immobility of the fracture was "the best opportunity for the nature to play its own game". He recommended the animals to be kept in a place calm and quiet and the extremity to be stabilized by the supportive braces called "splint" or "cast". In contrary, his experiences with the mentioned splints got him thinking that they were useless, non-necessary and far from being practical.

In other publications dated in the same years, the application principles of splints and braces along with the uses of materials such as plaster of paris, sodium silicate, and starch in these cases. These materials were mixed with water making a paste then applied on a bandage or a muslin and used afterwards. Following this application, cotton was placed as a support over the extremity and materials like wood or metal were placed on the cotton trying to provide stability. Water proof tapes were used to make sure the bandage stayed dry.

Development of the fluoroscopic technique in 1920 was one of the important primary developmental stages in the field of veterinary orthopaedics. Since then, visualising the position and movements of the bones simultaneously was quite magical and far from being imaginable for the orthopaedists. With the usage of x-ray and fluoroscopy, orthopaedics took a huge leap. These methods, first used in human medicine, then were applied to veterinary medicine in the fracture fixation. With the increasing number of vehicles on traffic and without a legal obligation of leashes, more and more cats and dogs were subjected to traffic accidents each day. Development of a long term effective anaesthetic agent such as sodium barbital enabled fractures to be fixated under fluoroscopy easily. Along with this, displacement and apposition of the fragments especially in long bones covered with big masses of muscle such as femur and humerus was still an unsolved big problem. The muscle contractions were a compelling element for fragment reduction. While veterinarians were struggling with these kinds of problems, doctors were taking results successful to a degree by generating traction on the distal fragment of the fracture. Dibbel has performed a similar method in femur fractures of dogs and applied traction to the fragments. Although he had some positive results, the materials he used for traction caused osteomyelitis (Dibbell, 1931).

Schroeder wrote the following in 1933, while he was working in Massachusetts General Hospital; "We believe that the reduction and fixation is usually non-effective in cases where they are not combined with some kind of traction, especially in femur and humerus fractures. In complete fractures, we should wait for total displacement. In these fractures, the reduction cannot be preserved because of non-even muscle contractions" (Schroeder, 1933).

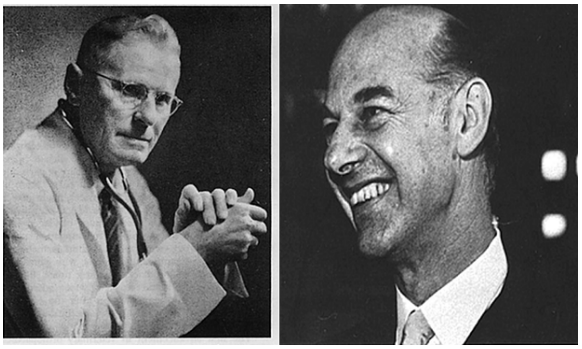

**Figure 4.** Ervin F. Schroeder and Jacques Jenny (from left to rigth)

Jones has developed a splint that prevents the fracture edges to overlap in human medicine (Jones, 1913). This splint was made of an appropriately shaped metal rod and provided traction to distal and proximal edges. The main idea of this splint was neutralisation of the muscle contractions and protecting the reduction with constant traction. Schroeder modified this splint in 1933 and started to use it in dogs. Schroeder was stabilising the splint using sticky tapes and rings supported with soft material and used this method in femur fractures (Schroeder, 1933). This splint had a very wide range of use and was applied on different animal species; it is still used by some practitioners in appropriate cases. To make the splint, dress hangers can be used for cats and small dogs and aluminium pipes can be used for large dogs; steel should be preferred for horses and cows. After applying the splint, the animal can maintain mobility which is an important advantage.

Despite the usage of splints and traction, x-ray and fluoroscopy imaging showed that there were some complicated fractures in which total anatomic reduction could not be provided. At this point, further investigations were being made on new and applicable methods, with the aim of getting more satisfying results. In fact, surgical approach and fixation of the fracture area was an appropriate method but sepsis and osteomyelitis were the worst nightmare of the surgeons back in the day and the results of the trials were intimidating.

Methods that provide visualization of the fragments such as the x-ray and fluoroscopy were the first stepping-stone then it was time to develop aseptic surgery technique and practice. This was the second big leap in the field.
Sterilisation of all the equipment, cloths that border the operation area, all the materials that will be in touch with the wound, aprons of the surgeons, gloves, masks and bonnets with either steam power or heat was recently started to be used in human medicine.

In operations made with aseptic surgeries, it was seen that the closed fractures in the long bones of extremities could be reached and intervened in 20-30 minutes and the wound could heal without any infection or discharge. In cases that the operation took more than half an hour, postoperative infection was still a big problem. Of course, usage of the aseptic method brought along the usage of the intramedullary pins and more positive results then splint and traction were taken.

The third big step in fracture repair was taken with the usage of antibiotics and sulphonamides. With the penicillin coming in to use in 1940, veterinary practitioners were armed with imaging techniques, aseptic surgery method and antibiotics and the post-operative infection rate was significantly decreased.

One of the biggest contributions to fracture fixation was from an old large animal practitioner, Stader Applications on fracture fixation were extremely interesting for Stader because it had mechanical implementations. Stader's father was an educated engineer who had developed patented neutering tools (Stader, 1934).

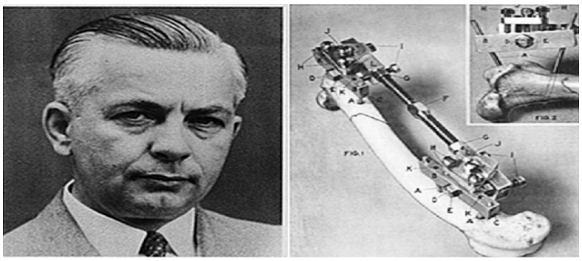

**Figure 5.** Otto Stader and his device

Stader was following the works of Swedish surgeon Gadvilli, who was making fixation with Steinmann pins in America closely. Gadvilli was using the Steinmann pins he located transversally inside the distal and proximal fragments to maintain reduction and then stabilised them by connecting to a brace after giving the bone the position he wanted (Olsson, 1969). Although this method was successful in humans, due to the contamination with urine and faeces, and biting the brace, there was no success in dogs.

The negative results got Stader thinking and working on a new, effective system; in the end, he developed the splint which was used with 4 short Steinmann pins two located on the distal and two located on the proximal fragment. In the splint, the pin pairs on distal and proximal were placed to make a "V", so the mechanic resistance would be the highest. The pins passed through the skin, muscles, lateral cortex and medullar cavity and slightly came out from the medullar cortex. After this is done and the fracture is reducted, the distal and proximal pin pairs were stabilised on a metal block. These blocks were then attached to each other by a metal bar. Due to the fact that the whole system was made of metal, it was quite rigid and easy to clean.

The system was welcomed warmly by the practitioners, university hospitals, and most importantly the US army. Stader's system started to be modified and improved rapidly by human physicians.

Trial of new approaches started after the Stader fixator came into use as a safe method in practice. It was providing a good opportunity especially for fracture repair with implants placed in the medullar cavity. For this purpose, bicycle rim stings, piano strings, silver strings, stainless steel and tantalum were tried. In addition, cattle bones, intestines, and tendons were processed and tried.

Usage of the metal implants has brought along new problems such as tissue reactions, metal oxidation, and metal fatigue. Fracture repair with the intramedullar pin application has found a wide range of use but the issues such as the pin end getting out of the bone into the joint, seroma accumulation on the skin-covered edge and penetration of the skin were yet to be solved. In the meantime, Jonas splint was developed; although it was a promising system at first, osteomyelitis-like tissue reactions and the need for resection of many cortical bones while removing the implant, it became history before becoming popular.

Jesse Hackley Rush developed hooked and curved steel pins named after himself and started using them in especially epiphysis or distal 1/3 corpus fractures (Rush and Rush, 1949). These pins were used in pairs and providing stability of the fracture by contacting the bone from 3 different points. The method which is still in use today was adapted to veterinary medicine by Carney in 1952 (Carney 1952).

Jacques Jenny (Jenny et al. 1946) used Küntschner nails on dogs in America where he came in 1950 after working in Europe; although the indications of this implant were limited, it was seen that they provide a stable fixation (Jenny 1950).

Plaques on the other hand were developed by Lane in 1907 (Lane 1895) and Sherman in 1912, and were 4-8 holed implants designed to be placed on the lateral surface of the fractured bone (Sherman 1912). After specification of the main application principles and material specialities by "Arbeitsgemeinschaft fur Osteosynthesefragen" AO/ASIF group founded in Switzerland in 1960s, plaques became one of the most successful methods used in internal fixation.
In the first half of 20$^{th}$ century, all the interest was on the fracture fixation because it was the most important problem

in the field of veterinary orthopaedics and the main subject was adaptation of the methods from the human surgery to animals. On the other hand, in the same period, Schnelle had noticed some oddness in the pelvic radiographies, in almost half these animals, the pelvic joint was arthritic. Schnelle has stated that although these animals had osteoarthritic changes on the caput femoris and acetabulums mobility of the animals was not significantly decreased and without a radiographic screening, it would easily go unnoticed in his articles between 1935 and 1937 (Schnelle 1935 and Schnelle 1937). He also took this subject to his colleagues and American Dog Club but they didn't take an interest on it back then. When the World War two started, Schnelle joined the army and saw that most the German Shepherds had this condition and therefore had trouble under the heavy training. This highly concerned the German Shepherd breeders, especially when they figured out it was a dysplasia.

In the same period of time, in Denmark, Moltzen and Neilson were reporting that the same problem was seen in small breeds, effecting one extremity and caused acute limping and muscle atrophy (Moltzen-Neilson 1937). Back then, it was considered to be hip dysplasia, but today it is named as "the aseptic necrosis of caput femoris" (Legg-Perthes-Calve) and is a different disease.

In the middle of 1940s, many other problems of the locomotor system were defined. Among these were congenital patella luxations in small and miniature breeds, intervertebral disc diseases in chondrodystrophic breeds, osteochondrosis dissecans and ununited anconeal process seen in the shoulder joint of large and giant breeds, and angular deformities formed due to early closure of the ulna's distal epiphysis in fast growing breeds.

Veterinary orthopaedics has started with fracture repairment, developed with orthopaedic diseases' diagnose and treatment methods. In our day, it is in close contact with sciences as genetics, biomechanics, bioengineering and biomaterials and continues to making progress.

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**Conflict of Interest**
The authors declare that there is no conflict of interest in the content of the article

**REFERENCES**

Francis A: The Genuine Works of Hippocrates, 1891, New York: William Wood and Company.

Brian, P., 1977, "Galen on the ideal of the physician", South Africa Medical Journal, 52: 936–938.

Bois-Regard NA, Baglivi G, Berger C, Du Cerf C, Fagon GC, Geoffroy EF, Hartsoeker N. De la generation des vers dans le corps de l'homme, de la nature et des especes de cette maladie; des moyens de s'en préserver & de la guérir. Paris, La Veuve Alix 1741

J. B. Kirkup. 1991. "Nicolas Andry and 250 years of orthopaedy," The Journal of Bone and Joint Surgery, 73-B(2), 361–362.

Muller G. Diseases Of The Dog. 1st Edition. Translated, revised and augmented by Glass A. Published by W Horace Hoskins, Philadelphia, 1897.

Perrin F: The treatment of fractures. 1923. North Am Vet 4:490.

Dibbell EB. 1931. Lower third femoral fracture in dogs. North Am Vet 12:37.

Schroeder EF. 1933. The traction principles in treating fractures and dislocations in the dog and cat. North Am Vet 14:32.

Jones Sir R. 1913. An orthopaedic view of the treatment of fractures. Am J Orthop Surg 11:314.

Stader O. 1934. Treating fractures of long bones with the reduction splint. North Am Vet 20:62.

Olsson, SE. 1969. Comparative Orthopaedics, Clin Orthop Related Res 62: 3-5.

Rush LV, Rush HL. 1949. Evolution of medullary fixation of fractures by longitudinal pin. Am J Surg 78:324.

Carney JP. 1952. Rush intramedullary fixation of long bones as applied to veterinary surgery. Vet Med 47:43.

Jenny J, Kanter U, Knoll H. 1946. Die Behandlung von Femurfrakturen des Hundes durch Marknagelung. Schweiz Arch Tierheilkd 85:547.

Jenny J. 1950.Kuntscher's medullary nailing in femur fractures of the dog. J Am Vet Med Assoc 17:381.

Lane WA. 1895. Some remarks on the treatment of fractures. BMJ.;1:861–3.

Sherman WO'N. 1912. Vanadium steel bone plates and screws. Surg Gynecol Obstet 14:629.

Schnelle GB. 1935. Some new diseases in the dog. Am Kennel Gaz 52:25.

Schnelle GB. 1937. Congenital subluxation of the coxofemoral joint in a dog. University of PA Bull 65: 15.

Moltzen-Neilson H. 1937. Calve-Perthes-Krankheit, Malum deformans coxae juvenalis bei Hunden. Arch wiss prakt Schweiz Arch Tierheilk 72:91.

Boone Eg, Johnson AL, Montavon P, Hohn RB. 1986. Fractures of the tibial diaphysis in dogs and cats. *JAVMA*, 188, 41–45.

Dudley M, Johnson AL, Olmstead M, Smith CW, Schaeffer DJ, Abbuehl U. 1997. Open reduction and bone plate stabilization, compared with closed reduction and external fixation, for treatment of comminuted tibial fractures: 47 cases (1980–1995) in dogs. *JAVMA*, 211, 1008–1012.

Nolte DM, Fusco JV, Peterson ME. 2005. Incidence of and predisposing factors for nonunion of fractures involving the appendicular skeleton in cats: 18 cases (1998–2002). *JAVMA*, 226, 77–82.

Rovesti GL, Bosio A, Marcellın-Little DJ. 2007. Management of 49 antebrachial and crural fractures in dogs using circular external fixators. *J Small Anim Pract*, 48, 194–200.