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History of Equine AOVET

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Summary: This manuscript leans heavily on the AO publication, History of AOVET – The First 40 Years by *Auer J. A., Pohler O. E. M., Schlünder M., Kása F., Kása G., Olmstead M., von Salis B., Fackelman G. E.* and is approved by the AO Foundation. Also, to be able to comprehend the spirit of the AO Foundation and AOVET, it is important to also elucidate the way the AO was founded. Up to the 1960s, veterinary practice consisted mainly of the treatment of food-producing animals (cattle, pigs, sheep, and goats) and some horses, which were used in agriculture and the World Wars. Small animals were not important at that time and were treated, when necessary, by the same veterinarians as the large animals. With time dogs and cats became more and more "family members" and the popularization of motorization resulted in an increased number of car accidents of small animals, and the demand by the animal owners to treat these patients properly. The horses were used more and more in sports and here as well, "state-of-the-art" treatments was demanded. However, the veterinarians lacked the knowledge of such treatments, implants, and instrumentation to properly carry out these demands. The same problems were noticed about a decade before by human surgeons. In addition, the increased popularity of alpine skiing and the related skiing accidents also demanded proper management of the acquired long bone fractures in humans. Four human surgeons, some of their associates and friends in Switzerland were not happy with the way human fractures were treated and decided to do something about it. They got together with some manufacturers of the watch making industry to find solutions for proper implants and the instruments needed for their implantation. In addition, recent developments in aseptic surgery and postoperative management had to be adopted. Together they came up with a system and started treating human patients, after having practiced the surgical interventions many times on cadaveric bones. The success was immediate, and they organized courses to teach other surgeons their techniques. The only way the implants and instruments could be purchased, was to first participate in an instructional course on the implants and instruments, combined with practical exercises on cadaveric bones. The AO (Arbeitsgemeinschaft für Osteosynthesefragen) was founded in 1958 and expanded rapidly over the entire globe. *Björn von Salis*, a private practitioner from Switzerland, wanted to improve the management of horses with fractured bones. He heard about a dog and horse owner in Waldenburg, who was manufacturing plates and screws for human patients with fractured legs, met with him and together they began to adapt the techniques, implants, and instruments developed for humans, to fractured horse bones. After treating several fractured cadaveric horse bones with good results, it was time to apply the gained knowledge to a living horse. For that purpose, a horse destined for slaughter was purchased, the animal anesthetized in its stall and two newly developed titanium plates applied by skilled human AO surgeons to an osteotomy of the third metacarpal bone. The animal survived the surgery and after the osteotomy had healed, the plates were removed. The horse also survived the second surgery and was kept as a pet. The plates were tested for potential microtrauma and cyclic loading. They were absolutely intact, and this paved the way, firstly for osteosynthesis of fractured horse bones and secondly, for the application of titanium plates to human fractures. In the facilities of the Straumann Institute in Waldenburg, *von Salis* and some small animal surgeons around Basel, continued to study the possibilities fracture management and it did not take long until veterinarians, including equine surgeons, participated in human AO Courses. Eventually, equine courses in basic techniques and later master courses for horse specialists were organized. This started rapid development of surgical techniques for all major equine fractures, which eventually were applied in all university hospitals and major equine clinics in Europe, the USA, Canada, Australia, New Zealand, Japan, and Hong Kong. AOVET has served as "incubator" for the development and expansion of equine fracture treatment across the World – with the help of the AO Foundation.

Keywords: AOVET, history, osteosynthesis, equine, fracture treatment

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Foreword

The history of AOVET for horses/equids is intimately intertwined with the development of AOVET for small animals and the other specialties of the AO Foundation. In this manuscript, the focus is placed on the activities for horse specialists. However, to place the activities in relation to the original human AO, an excerpt on the foundation of the AO Foundation is needed. This manuscript leans closely on the AO publication History of AOVET – The First 40 Years by *Auer J. A., Pohler O. E. M., Schlünder M., Kása F., Kása G., Olmstead M., von Salis B., Fackelman G. E.* and is approved by the AO Foundation. (AO was soon translated into ASIF = Association for the Study of Internal Fixation. The acronym "AO" could not be used in the USA because "American Optical" had its right of use already assured. With the closure of the last division of American Optical in 2010, the acronym "AO" has become available for the AO and since then it is used world-wide – the acronym "ASIF" was at that time abandoned in the USA.)

The past

Up to the middle of 20th Century, the veterinarians in rural settings were mainly occupied with the treatment of food producing animals (cattle, sheep, goats, pigs) and some working

and Word-War horses. If necessary, they also took care of dogs and cats, for which no expensive treatments were afforded, because replacement was so natural and inexpensive. In mid-1900, the disappearance of horses as working animals and the industrialization with increasing introduction of machines like tractors, had a strong impact on the veterinarians, not only regarding their professional identity, but also economically (*Jasny* 1935, *Bairoch* 1976, *Klemm* 1992, *Achilles* 1993, *Seidl* 1995, *Swabe* 2000, *Johns* 2003, *Schrepfer* and *Scranton* 2004, *Gardiner* 2006). Since then, horses have been primarily used for pleasure riding, and various sports activities, including racing, dressage, show jumping, eventing, and Western riding.

At the same time, especially in cities, dogs and cats increased in large numbers, and were kept as pets (*Thomas* 2000, *Grier* 2006). The emotional attachment to these animals resulted in the increasing commercialization of pet management (the breeders, the pet food industry and for veterinarians). Whereas at the beginning of the twentieth century small animal practitioners could be found only in small numbers and only in large cities, they started to increase in numbers in the 1950s and 1960s and are now dominating veterinary medicine and surgery (*Swabe* 2000, *Johns* 2003, *Rock* and *Babinec* 2008). Because pet owners were inclined to spend an increasing amount of time and money for their beloved, emotionally highly valued animal companion, veterinarians were able to apply more demanding treatments.

Before, veterinarians had been trained based on the functional pragmatism that ruled the lives of working animals (*Frick* 1906, *Schwendimann* 1926, *Jung* 1997, *Swabe* 1999). In the context of pet ownership, the veterinarian's mission changed; it was no longer about curing inexpensively or otherwise killing the sick animal. The treatment of pets and horses followed more the model of human medicine instead, something that was more and more expected by pet and horse owners. The veterinarians thus switched from functional pragmatism to an "economy of love" as a basis for their work. This switch, however, confronted them with the fact that they often did not know how to treat an animal according to the human medical practice.

Insufficiency in operative fracture treatment

These problems were particularly relevant for veterinary surgery, especially in the field of trauma- and orthopedic surgery. The rapid increase in the numbers of motor vehicles resulted in growing numbers of animals injured through traffic accidents (*Degeling* 2009). The injuries they suffered were more complicated than those caused by a simple accident, fall, or kick by another animal. Thus, the veterinarians were challenged quantitatively with more fractured bones and qualitatively with more complicated fractures. The animal owners expected an effort by the veterinarians to save the lives of their pets, whenever possible. Yet in the 1950s and 1960s veterinarians' knowledge, and treatment options for dogs, cats, and horses with broken bones were quite limited, although certain adoptions from human trauma surgery had been made (*Becker* 1956, *Dietz* 1959), *Degeling* 1993, *Schäfer* 1993, *Cooter* 1997, *Schilch* 2006) .

While operative fracture treatment by intramedullary nailing corresponding to the *Küntscher*'s technique was very popular in small animals (*Küntscher* 1940, *Küntscher* and *Maatz* 1945), these techniques were not applicable in horses and cattle. Therefore, fracture treatment in large animals during the 1950s and 1960s was even more problematic than in small animals and had many shortcomings.

In large animals, operative fracture treatment was extremely difficult, although occasionally attempts were undertaken. *Dieter Prieur* (1985) refers to an early case, where in 1891 in Cairo, a horse of the city police that had suffered a broken jaw was successfully treated with a cerclage wire-suture, which allowed the horse to be back at work after 10 months. *Willi Eppenberger* (1966) reported on compression plate osteosyntheses of fractures of the lower jaw in cattle, which he carried out in collaboration with Dr. med *Reinhard Fischer*, an experienced human AO surgeon.

Systematic approach to osteosynthesis in human surgery developed by the AO group

On November 6, 1958, the AO (Arbeitsgemeinschaft für Osteosynthesefragen) was founded in Biel, Switzerland. Based on private individual interest and driven by the search for improved and dependable osteosynthesis techniques, the five surgeons of the core group, who initiated the formation of the AO (Professors *Maurice Müller, Martin Allgöwer, Hans Willenegger, Robert Schneider, and Walter Bandi*) (Fig. 1) had met numerous times between 1952 and 1956 exchanging their experiences, concerns and proposed new concepts (*Heim* 2001). They concentrated increasingly on collaboration, systematic work, and the analysis of clinical problems. By 1957 they were able to formulate essential preconditions for successful operative fracture treatment stressing the im-

Fig. 1 Archive picture of the five founders of AO: (top row) *Martin Allgöwer* (left) and *Maurice Müller* (right); (bottom row) *Robert Schneider* (left), *Hans Willenegger* (center), and *Walter Bandi* (right). (Courtesy AO Foundation, Davos). | *Archivbild der fünf Gründer von AO: (oben) Martin Allgöwer (links) und Maurice Müller (rechts); (unten) Robert Schneider (links), Hans Willenegger (Mitte) und Walter Bandi (rechts). (Mit freundlicher Genehmigung der AO-Stiftung, Davos).*

portance of a functional view on osteosynthesis. In December 1957 they decided on the formation of an "Association pour Osteosynthèse" (*Schneider* 1983, *Heim* 2001). At an internal meeting in March 1958, they demonstrated and evaluated all the osteosynthesis equipment available at that time. The results were disappointing, and the five surgeons decided to develop their own instrument and implant systems and surgical methods for the different fracture types and orthopedic interventions. *Müller*, the most highly motivated and most active of them all, presented an overview of the "aims and general principles of modern osteosynthesis in adults" that sounded almost like an AO program (*Schneider* 1983). Among other aspects the following characteristic points were included – these points are still part of the AO philosophy today:

Aims:
- Early postoperative mobilization and activation of near-fracture joints and muscles; this is very effective but must not be forced too much
- Reconstruction of the anatomical conditions; this is a precondition for functional results

Basic principles:
- Continuity of asepsis from accident to healing; postoperative wound drainage; careful anatomical operation, reconstruction, and reduction
- The fractured area should be transformed into a stable block by the osteosynthesis
- Where possible fragments should be set under compression for increased stability
- Pseudarthroses tend to heal quickly under compression, but the sources for the pseudarthroses should be detected and treated if required
- The implant materials must be biocompatible

The various aims and concepts were followed up meticulously, with astonishing momentum and personal engagement. To implement the agreed development of instruments and implants, *Müller* visited *Robert Mathys* in spring of 1958 at his production company for stainless-steel products in Bettlach, Switzerland.

Robert Mathys started immediately with the designing and manufacturing of prototypes, so that the first samples of the 4.5 mm screws with the corresponding (round-hole) plates and implantation-instruments were available already at the founding meeting in November of the same year (1958). Thus, *Mathys* was the first manufacturer of AO implants and became the first exclusive producer of AO products (later to become Synthes products) and contributed substantially to the development of the equipment.

The AO surgeons were so successful because they approached operative fracture treatment on an unusually broad and systematic basis and at a point in time when important new techniques in various fields like metallurgy, physics, aseptic surgical techniques, and perioperative antibiotic management were developed and became available to solve major problems of bone surgery.

The core group developed implants, instruments, surgical techniques, and after-care protocols simultaneously. They studied the biomechanics of the normal skeleton and of the injured and treated bones, and they investigated osteogenesis and bone healing mechanisms under various conditions histologically and metabolically. In 1959 the AO Research Institute for Experimental Surgery was established in Davos, Switzerland supported by the particular initiative of *Allgöwer* and by the financial donations of the AO members. The Documentation Center for the clinical cases of the AO members was moved there, and a tissue culture laboratory was installed soon. This laboratory also allowed them to address the question of metal toxicity and led to the early studies of biocompatibility of implant materials and their components by Dr. *Lotte Hulliger* and *Ortrun Pohler* (*Hulliger* et al. 1967, *Straumann* 1967). Prof. *Herbert Fleisch* led the AO Research Laboratory from 1963 on during the first years. His special research interests were bone biochemistry and metabolism, as well as bone pathology and the development of medications for bone disorders. In 1967 Prof. *Stephan Perren* took over the helm of the Research Institute as its director and continuously expanded its facilities as well as its organization, engagements, and the subjects of research at the highest level. He implemented biomechanical, biological, and mechanical testing and analyses, histological, and clinical research, cell and organ culturing and biocompatibility studies, as well as the development of implants and instruments. The AO Research Institute was also engaged in the development of systematic AO educational activities and provided an enormous teaching and operative support for the yearly Davos courses. The accumulated knowledge and know-how of the AO Research Institute contributed tremendously to the success of the AO concepts, the AO Organization, and eventually the spreading of the word globally.

After the Institute Straumann in Waldenburg was contacted by the AO in 1960, it became instrumental in the development of implant materials that possessed the required biocompatibility, corrosion resistance and variability in mechanical properties (*Heim* 2001, *Schilch* 2002). As a result, the Institute Straumann became the second exclusive producer in 1962 (*Hulliger* et al. 1967, *Straumann* 1967, *Schneider* 1983). In 1974 the 3rd exclusive producer of AO was established: Synthes USA with *Hansjörg Wyss* as director. The AO, together with its producers, pursued a strategy of standardization and quality control of instruments and implants and of teaching the proper equipment handling and corresponding operative techniques.

However, with the propagation of the "compression-osteosynthesis technique" where screws and plates create reduction of the fracture gaps and axial compression at the end of the bone fragments, the AO surgeons provoked the opposition of their colleagues. Because the common opinion was that compression destroys the bone. Another, related, controversy arose about the phenomenon of "callus-free healing", which was detected in connection with the stable osteosynthesis techniques. At that time, it was generally accepted to interpret callus formation as a sign of progressing bone healing and the surgeons concluded wrongly that the missing callus with stable internal fixations would indicate a lack of bone healing. The experimental clinical and histological research conducted by *Willenegger* (Hospital Liestal near Basel) and Prof. *Robert Schenk* (University of Basel at that time) demonstrated on dog-radii that with sufficiently stabilized osteotomies primary direct bone healing occurs without callus formation (*Schenk*

1963, *Schenk* 1964) (Fig. 2). *Perren* showed with his strain gauge measurements on experimental compression-osteosyntheses on sheep in combination with related histological investigations that no bone resorption occurred by the exerted compression (*Perren* et al. 1969). These scientific findings together with the many documented successful clinical cases soon convinced the surgical orthopedic community. The meticulous documentation and critical evaluation of the clinical cases as well as learning from complications were important milestones of the AO philosophy. The tradition of yearly spring and fall "closed" membership meetings associated with "open" scientific sessions provided a forum for information, exchange of experience, and coordinated clinical projects.

The AO members obtained more and more requests from their colleagues who wanted the AO equipment for their own surgery. Since the operation techniques were subtle and the risks of probable complications high, the AO decided to sell the equipment only to surgeons who were well trained and attended a special instructional course. At the same time, it was agreed with Dr. *Peter von Rechenberg* of Synthes AG in Chur, that earnings from the sale of the surgical equipment would flow back into the research for further development. In December of 1960 the first AO course was offered in Davos with lectures and practical exercises using original implants and instruments on cadaveric human bones – later replaced by polyurethane models. From then on, every year until today these Davos courses were offered, growing in numbers and diversity of their content. Nowadays, AO Courses are offered all across the globe. The corresponding teaching material was developed and continually updated, including the videos for the practical exercises. The first AO Manual with descriptions of the various operation techniques for typical fracture treatments and general introductory information was published by *Müller* et al. in 1963 (*Auer* et al. 2013).

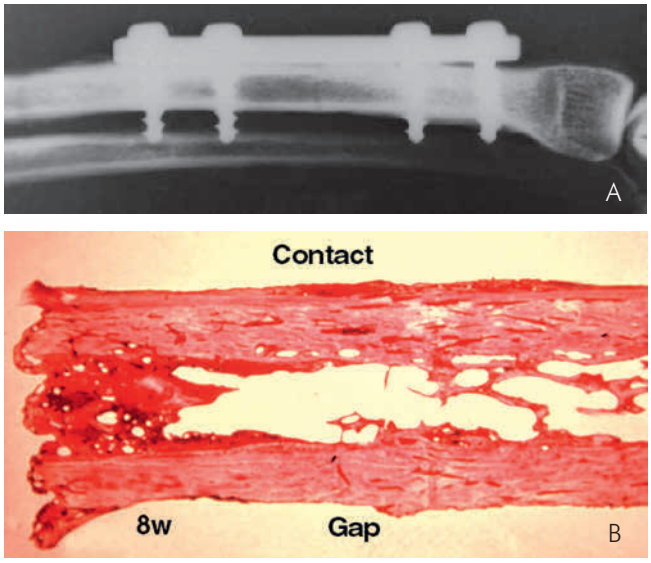

Fig. 2 Pictures of the original research conducted *Robert Schenk* (1963) in dogs: direct bone healing of a midshaft radius osteotomy repaired by a compression plate. A, lateromedial radiographic view of the repaired osteotomy; the osteotomy is visible between the two center screws. B, 8 weeks postop histologic slide of the healed bone. No callus is visible. The left edge of the specimen represents the shape of the screw threads. The healed osteotomy is still recognizable on the left of the "p" of the word "Gap". (Courtesy AO Foundation, Davos). | *Bilder der Originalforschung von Robert Schenk (1963) an Hunden: direkte Knochenheilung einer Mittelwellenradiusosteotomie, die durch eine Kompressionsplatte repariert wurde. A, lateromediale Röntgenaufnahme der reparierten Osteotomie; die Osteotomie ist zwischen den beiden Mittelschrauben sichtbar. B, 8 Wochen postop histologische Abtastung des verheilten Knochens. Es ist kein Kallus sichtbar. Die linke Kante des Musters stellt die Form der Gewinde dar. Die verheilte Osteotomie ist immer noch links vom „p" des Wortes „Lücke" zu erkennen. (Mit freundlicher Genehmigung der AO-Stiftung, Davos).*

How AO VET started

Björn von Salis

Some conditions, and several occurrences that took place at about the same time, led to the formation of the initial group of veterinarians, human trauma surgeons, and scientists that eventually resulted in the founding of AO VET (*Prieur* 1985).

The experience as a teenager of *von Salis* (Fig. 3), witnessing a horse to be shot after fracturing its leg, led him to become a veterinarian. His goal was to prevent such cruel incidents in the future. As a senior veterinarian at the Equine Hospital of the University of Bern in the 1950s, he went to study equine anesthesia with Leslie Hall, who was starting to use inhalation anesthesia with Halothane. After returning to Switzerland, he introduced these techniques into the daily routine at the hospital (*von Salis* 1964). Then he worked on new means of transportation facilities for horses after an accident. This challenged him to construct an ambulance vehicle equipped with an x-ray unit and first aid facilities.

In the mid 1960s, *von Salis* left the University of Bern and moved on to work in a small animal practice in Basel so that he could complete his specialty degree in small animal surgery and medicine. There he became friends with *Drs Ferenc (Feri)* and *Gerhilde (Geri) Kása*, small animal veterinarians who practiced and lived in Lörrach near Basel on the German side of the river Rhine. *Björn von Salis* never forgot the need to look for adequate implants and instruments for trauma surgery in horses.

Fig. 3 *Björn von Salis* – the initiator of AOVET at an AOVET fondue party during an Equine course in Davos. | *Björn von Salis – der Initiator von AOVET bei einer AOVET Fondueparty während eines Pferdekurses in Davos.*

An animal owner and engineer

In 1954 *Fritz Straumann* (Fig. 4) and his father, Prof. *Reinhard Straumann*, had established a private research institute in Waldenburg (near Basel) to facilitate further development, investigations, and testing of watch-spring materials and watch-spring designs that his father, *Reinhard Straumann,* had invented. The spring metal-alloys were sophisticated, and their production processes required close attention and metallurgical expertise. *Fritz Straumann* was very interested in all natural sciences and in the technical field, and expanded the developments for the watch industry and to other areas as well. The concept was to invest the earnings of their patents into their research institute.

In 1960 *Fritz Straumann* was contacted by *Willenegger* who was seeking help for the improvement of the material quality of the AO implants because there appeared problems with the corrosion and breakages of plates and screws. *Pohler*, a metallurgist, working at Institute Straumann, analyzed the defective implants and found that impurities and the faulty composition of the stainless steel were the reason for the corrosion. The failure of the implants was caused by a material fatigue mechanism where a crack propagates with time by cyclic loading. Such critical local bending stresses can be generated under the load bearing of the patient, in areas where bony defects are protected by stainless steel implants. With time this phenomenon was studied in depth (*Pohler* and *Straumann* 1980). *Fritz Straumann* provided the development of a stainless steel with high corrosion resistance and variable mechanical properties particularly suited for clinical applications. This material became the model for the internationally standardized implant steel until today.

Fritz Straumann was also a passionate horseman. He owned several horses for himself, his wife, and children, and kept them near their home. The family also owned Blood Hounds and Bassets. In 1967, when one of the dogs became very sick, *Fritz Straumann* took it to Dr. *Christoph Uehlinger,* a small animal practitioner in Basel, and there he met *von Salis*.

Fig. 4 Dr. *Fritz Straumann*, the owner of the *Straumann* Institute, Waldenburg was not only one of the producers for the instruments and implants for the AO, but also a great supporter of the needs of the young AOVET. | *Fritz Straumann, Inhaber des Straumann-Instituts, Waldenburg, war nicht nur einer der Produzenten der Instrumente und Implantate für die AO, sondern auch ein großer Förderer der Bedürfnisse des jungen AOVET.*

Getting together

Uehlinger knew about *Fritz Straumann*'s engagement in the development of instruments and implants for fracture care in humans and mentioned this to *von Salis*. Shortly after, *von Salis*, equipped with his publications on horse anesthesia and a Dutch book by *Willem Verhaar* (1964) on operative fracture management in large animals, visited *Fritz Straumann* at his home in Waldenburg. The two men got along very well from the start. Their first conversation lasted until three o'clock in the morning. At the end of the conversation *Fritz Straumann* offered his and his laboratory's full support for the development of instruments and implants for animals and asked *Pohler* (Fig. 5), to take over the "animal-project". Weekly Wednesday afternoon meetings at the Institute Straumann in Waldenburg were scheduled to explore the possibilities. Soon *Ferenc* and *Gerhilde Kása* joined him.

The Waldenburg circle

Studies of osteosynthesis in large animals

The first step involved finding answers for several questions:
- What type of fractures occur in horses?
- How could such fractures be stabilized with already existing AO implants?
- What specific implants and instruments needed to be developed?
- Would such fixations remain stable under the heavy weight bearing loads of an adult horse?
- Would the so-treated fractures eventually heal?

Björn von Salis had collected fractured horse bones from animals that had to be slaughtered, and he took radiographs of the bones with the mobile x-ray unit. With the help of the largest human implants, 4.5 mm screws and round-hole plates they were able to repair several simple, not comminuted fractures of these bones. However, they realized that fractures of the femur and humerus were "nontreatable". The mechanical loading tests, which followed, demonstrated that it was extremely important to apply the compression plates and screws in a biomechanically optimal way as taught by the AO principles for human surgery. Also, precise anatomical fracture reduction was necessary to achieve sufficient stability to allow the pa-

Fig. 5 Dr. *Ortrun Pohler*, metallurgist at the *Straumann* Institute, was the soul of the young AOVET. | *Dr. Ortrun Pohler, Metallurgin am Straumann Institut, war die Seele des jungen AOVET.*

tient the necessary immediate postoperative full weight bearing of the treated leg. Some implants and instruments had to be adapted to the dimensions of the horse bones and others newly developed. With time a 5.5 mm animal cortex screw was developed by *Pohler* providing improved strength and good holding resistance in cortical and cancellous bone (*von Salis* 1972).

One major question remained to be solved: Would such stabilized fractures really heal, and how long would it take?

In November 1968 after many practical exercises on cadaveric horse bones, it was time to apply the gained knowledge on a life horse. *Fritz Straumann* purchased a horse, destined for slaughter, to serve for this purpose. "Maxlie", as the horse was named, was anesthetized in its stall and maintained in anesthesia with the first BOC "to and fro" portable anesthesia machine used in horses, a novel practice at that time. The right foreleg was aseptically prepared for surgery and properly draped. After the surgical approach a mid-third metacarpal transverse osteotomy was performed, with the help of the Straumann Institute's newly developed atraumatic, oscillating AO bone saw. A broad 9-hole and a narrow 6-hole titanium dynamic compression plate (DCP) 4.5 were applied to stabilize the osteotomy (Fig. 6A). The application of these plates to a heavy horse was a welcome test, not only to evaluate their use in horses, but also to test the feasibility of using titanium in orthopedic surgery. This intervention was performed by *Perren*, *Peter Dätwyler*, *Urs Guggenbühl*, *von Salis*, and *Fritz Straumann*. Two employees at the Straumann Institute assisted as "operating room nurses". Maxlie recovered uneventfully from surgery and no complications developed postoperatively, despite the surgical intervention having occurred in the horse barn (Fig. 6B). After the bone had healed all the implants were removed and investigated at the Straumann Institute, which revealed neither damage nor wear and tear of the implants used. Maxlie spent the rest of its life healthy and without any detrimental effects with *Fritz Straumann*'s other horses.

This successful osteosynthesis paved the way for the internal fixation in the first clinical equine cases in the equine clinic of *von Salis* in Frauenfeld, the first private clinic with surgery facilities, aside from the equine hospitals at the veterinary schools at the Universities of Zurich and Bern. The surgical interventions at *von Salis'* clinic were performed by human AO surgeons *Guggenbühl* and *Dätwyler* who had to take care of their human patients during the day. Therefore, the osteosyntheses had to be performed during the nighttime or holidays. One night, when lightning struck an electrical distribution center in the region causing loss of electricity in the whole region, the final sutures at a surgical intervention on a horse had to be performed with the help of automobile headlights.

The foundation of AOVET and pioneer work

The founding of AOVET

The next step after the successful osteosynthesis on "Maxlie" and on a series of small animal patients, was the participation of the members of the "Waldenburg Circle" on the human AO courses in Davos in December 1968. It was a logical sequence of events to pursue the idea to form an AO group for veterinarians with the aim to study and introduce osteosynthesis along the AO principles into veterinary medicine. The AO Board reviewed the efforts done by "Waldenburg Circle" and their few, but solid successes achieved applying human criteria to their patients and immediately agreed on the formation of an AO veterinary group.

On August 31, 1969, AOVET (*Prieur* 1985) was founded at an official ceremony carried out by *Willenegger*, one of the four AO founders, in the city hall of Waldenburg. In addition to the founding members (*von Salis, Pohler, F. Straumann, Guggenbühl, F. and G. Kása*, and *Dätwyler*, several Swiss, German, French, Dutch, and US veterinarians were present, together with some friends from the AO and the Institute Straumann. *Björn von Salis* was elected the first president of AOVET with *Pohler*

Fig. 6 "Maxlie", a Swiss light draft horse, destined for slaughter was saved by *F. Straumann* to serve as a research horse. Two newly developed Titanium plates were applied to the MCIII osteotomy. A, 34-week postoperative x-ray of the treated bone showing complete healing of the bone without callus formation and the two plates. B, "Maxlie", after it recovered from the surgery. (Courtesy AO Foundation, Davos). | *„Maxlie", ein Schweizer Leichtzugpferd, das zur Schlachtung bestimmt war, wurde von F. Straumann als Forschungspferd gerettet. Zwei neu entwickelte Titanplatten wurden an der MCIII-Osteotomie angebracht. A, "Maxlie", nachdem er sich von der Operation erholt hatte. B, 34-wöchige postoperative Röntgenaufnahme des behandelten Knochens mit vollständiger Heilung des Knochens ohne Kallusbildung und der beiden Platten. (Mit freundlicher Genehmigung der AO-Stiftung, Davos).*

acting as secretary and liaison to the AO group. The constitution of the AO was adopted by AOVET with certain modifications, particularly regarding the criteria for membership. The AOVET group intensified and systemized their work enthusiastically. The clinical cases treated by the AOVET members were documented in Waldenburg on cards with pertinent data and copies of the radiographs. The surgeons obtained copies of those cards from their cases. In analogy to the AO rule, a spring and a fall meeting were organized each year with clinical and administrative membership sessions. *Müller*, another AO founding member, asked *Guggenbühl* officially to take over the responsibility that the veterinarians carry out their osteosyntheses properly in the sense of the AO principles.

Fritz Straumann continued to provide support and access to the laboratories of his institute. *Pohler* worked systematically with other employees for the internal and external organization of AOVET, the development of implants and instruments for large and small animals, the performance of testing and research, and preparation of teaching aids. Through her AOVET was also – first indirectly, later directly – represented in the Technical Commission (TK) of the AO.

In large animals osteosynthesis was performed with astonishing results (Fig. 7), however the possibilities remained restricted because of the large size of the animals, as well as the anatomical and biomechanical conditions. One practical aspect of the veterinary conditions during the pioneer times must be kept in mind – when the veterinary activities on AO osteosynthesis started, private practices and even university clinics were not equipped for the performance of aseptic osteosyntheses corresponding to AO human clinical standards. A decision to include such AO open fracture treatment techniques into the clinical routine of veterinary practices or clinics required considerable investments in technical units such as high-quality x-ray and sterilization equipment, implants, and instruments. Thus, to the veterinarians, osteosynthesis appeared to be an expensive hobby. Also, the performance of the surgical interventions was still very time-consuming because an economic routine was still lacking. Furthermore, there were no reimbursements from health insurance plans – neither for small nor large animals – unlike the insurance policies for human patients, and so the animal owners could not be asked to pay for the actual costs. Only slowly, with the increasing establishment of the successful osteosyntheses and the growing attitude of the animal owners to consider their pets as members of the family with the responsibility to provide them with the best possible medical treatment, were the veterinarians able to obtain adequate reimbursement from the animal owners for their work (*von Salis* 1972, *Guggenbühl* et al. 1973). There exists some trade off in so far as the stable internal fixation techniques allow very early postoperative discharge of the animal patients from the clinics and in doing so reducing treatment costs considerably.

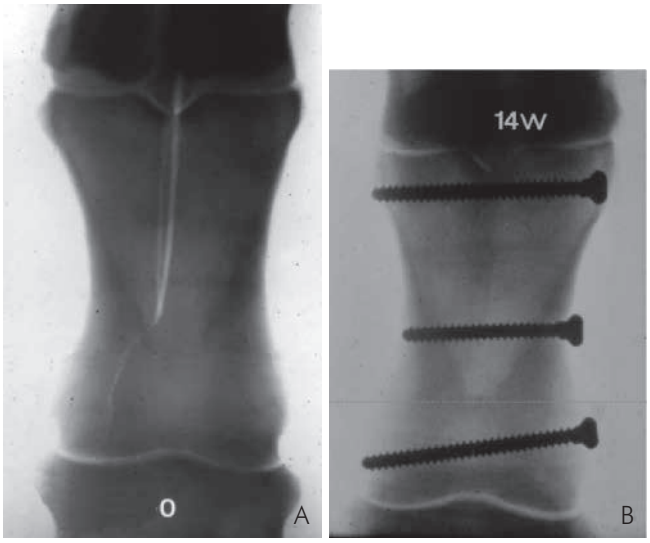

Fig. 7 One of the first sagittal proximal phalanx fractures successfully treated by *Björn von Salis* with three cortex screws in lag fashion. A, DP radiographic view of the fracture; B, 14-week follow up DP radiographic view of the healed fracture. (Courtesy AO Foundation, Davos). | *Eine der ersten sagittalen proximalen Phalanxfrakturen, die Björn von Salis erfolgreich mit drei Kortexschrauben behandelt hat. A, DP-Röntgenbild der Fraktur; B, 14-wöchige Nachbeobachtung; DP-Röntgenbild der verheilten Fraktur. (Mit freundlicher Genehmigung der AO-Stiftung, Davos).*

International activities of AOVET

AOVET enjoyed an immediate international response. In the early 1970ies, in addition to the courses in the USA and Davos, Switzerland, courses were offered in Sweden, Finland, England, and France. The courses offered approximately the same content because the members of the course faculties (lecturers and instructors) remained almost the same throughout Europe and North America. The basis for this type of cooperation was the supporting structure of the AO organization and the friendship and loyalty among the veterinarians themselves, and their common goal in developing systematic operative fracture treatment in veterinary medicine. The elaboration of the multitude of surgical treatments for the different fracture types and orthopedic corrective interventions in the different anatomical areas resulted in the publication of the first "Manual of Internal Fixation in the Horse" (*Fackelman* and *Nunamaker* 1982). Nineteen years later, the multiauthored "AO Principles of Equine Osteosynthesis", was published, which also contained a CD-ROM containing all the equine teaching videos. (*Fackelman* et al. 2001).

In the USA, veterinarians had no intention to form a national AOVET group. Therefore, they became individual members of the existing AOVET organization. The same type of individual AOVET membership was arranged for members from other countries.

The hop over the big pond

A Great Saint Bernard dog with a comminuted fracture of the femur was presented to *Bruce Hohn* (Fig. 8), head of Small Animal Surgery at the Animal Medical Center (AMC) in New York, USA. He had heard about a certain Prof. Dr. *Howard Rosen* of the Hospital of Special Surgery, New York, who was using metal plates and screws to stabilize fractures in people and having great success with it. *Rosen* was the first American MD who registered for an AO Course in Switzerland, and therefore was able to purchase the AO instruments, plates, and screws, which he could all fit into his suitcase upon his

return to the USA. At that time, *Rosen* (Fig. 9) was the only MD surgeon in North America who applied AO principles and soon became one of the course instructors in Davos. There were no courses taught for MDs in North America at that time. *Hohn* contacted *Rosen* and asked him if he could borrow the marvelous equipment to repair the dog's fracture. Because *Rosen* knew that *Hohn* did not know how to use the instruments and plates, he proposed to bring his equipment to the AMC and they could repair the fracture together. That was the start of a life-long friendship. *Rosen*, a gentleman and one of the most prolific, charismatic, and distinguished teachers of AO techniques maintained a special interest towards AOVET members and their patients through the rest of his life. He was invited to numerous AOVET courses and meetings of the Veterinary Orthopedic Society (VOS) to speak on his favorite topic "Complications". He celebrated the contacts with the veterinary group and especially the equine surgeons and inspired many young residents to enter the path of veterinary orthopedic surgery.

In December of 1969 *Hohn*, *Wade Brinker*, a small animal surgery professor at Michigan State University, and *Jacques Jenny*, a Swiss Ex Pat, who was teaching equine surgery at the University of Pennsylvania at the New Bolton Center, took part of the human AO Course in Davos, Switzerland. *Jenny* (see Fig. 9) established the AO techniques at his school before his untimely death in 1972. The last horse *Jenny* performed surgery on was Hoist the Flag, which acquired a comminuted fracture of the proximal phalanx and a condylar fracture of the adjacent third metatarsal bone of the right hind leg. The 6-hour surgery was successful and at the end of the surgery the first ever fiberglass cast was applied to the injured limb. Hoist the Flag was a mean horse; it bit off the thumb of the groom during one of the cast changes.

During the above-mentioned course in Davos 1969, *Hohn* met *Fritz Straumann* and *Pohler*. There they decided to organize the first AOVET Course. So, in March of 1970 ninety-nine veterinarians and faculty were present for the first annual course on "Internal Fixation of Fractures and Nonunions." This course was cosponsored by the Ohio State University and the AO. In the following year, the veterinary course was combined with a human AO course – the first human AO course of that type offered in the USA. An equine course was also added to the event with the help of *Jenny*. As previously mentioned, *Jenny* passed away a year later and could therefore not reap the fruit of all his work.

Fig. 8 Prof. *Bruce Hohn* was the first American to organize AOVET Courses in the United States. From the second course, the following year Human courses were added and maintained until they moved to Sun Valley, Idaho. After his untimely death, Prof. *Marvin Olmstead* took over the reign of the American AOVET courses in 1997. | *Prof. Bruce Hohn war der erste Amerikaner, der AOVET-Kurse in den Vereinigten Staaten organisierte. Ab dem zweiten Kurs wurden im folgenden Jahr Human-Kurse hinzugefügt und gepflegt, bis sie nach Sun Valley, Idaho zogen. Nach seinem vorzeitigen Tod übernahm Prof. Marvin Olmstead 1997 die Leitung der amerikanischen AOVET-Kurse.*

From then on, the courses in Columbus were offered annually with *Hohn* as General Program Chairman and in 1997 Dr. *Marvin Olmstead* became Co-chairman of the courses. The Equine courses were chaired by Prof. *Al Gabel* with Dr. *Larry Bramlage* as Co-chairman.

In the early 1970s *Hohn* and *Olmstead* were responsible for developing teaching videos for practical exercises in the small animal courses following the guidelines of the AO and in 1977 Prof. *Gustave (Bud) Fackelman* (Fig. 10) took his young

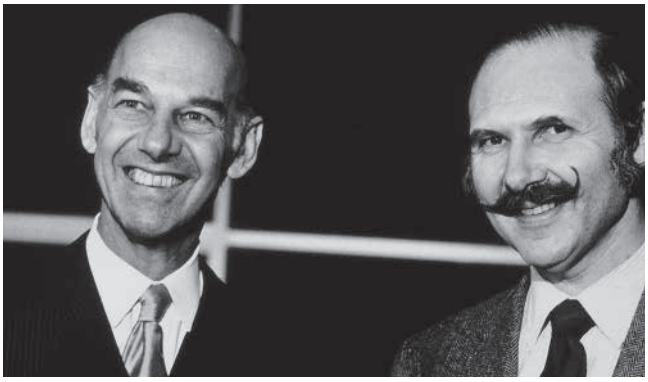

Fig. 9 Prof. *Howard Rosen* and *Jacques Jenny*. *Rosen*, the first American human surgeon to purchase AO instruments and implants after participating at an AO Course in Davos, Switzerland. *Jenny* was the first equine surgeon promoting AO techniques in the USA. | *Prof. Howard Rosen und Jacques Jenny. Rosen, der erste amerikanische Humanchirurg, der nach der Teilnahme an einem AO-Kurs in Davos, Schweiz, AO-Instrumente und Implantate kaufte. Jenny war der erste Pferdechirurg, der AO-Techniken in den USA förderte.*

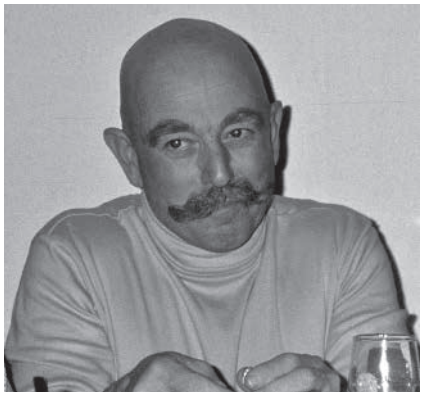

Fig. 10 *Gustave (Bud) Fackelman*, after leaving the University of Zurich in 1973, where he served as head of equine surgery, moved to the University of Pennsylvania to succeed *Jacques Jenny*. He was instrumental in helping the equine aspect of AOVET to be established in the USA. | *Nachdem Gustave (Bud) Fackelman 1973 die Universität Zürich verlassen hatte, wo er als Leiter der Pferdechirurgie tätig war, wechselte er als Nachfolger von Jacques Jenny an die University of Pennsylvania. Er war maßgeblich an der Etablierung des Pferdeaspekts von AOVET in den USA beteiligt.*

resident, Dr. *Joerg Auer* to Columbus before the courses, to prepare the first teaching videos for the equine course.

The equine side of AOVET in North America was mainly promoted by *Al. Gabe*l of the Ohio State University, and *Fackelman* of University of Pennsylvania. With time, younger faculty emerged among whom *Bramlage* and *Auer* are mentioned as the ones filling the footsteps of their teachers.

Following *Hohn*'s untimely death in 1986, *Olmstead* became General Program Chairman and shortly after *Bramlage* was named Co-chairman for the Equine courses, assisted by Dr. *Alan Ruggles* of Rood and Riddle Equine Hospital, Lexington, USA (Fig. 11). Also, in alternate years an Equine Master Course was added to the small animal courses in San Diego.

Spreading the word – AOVET center Waldenburg

To support the expansion of AOVET, an AOVET Center was established in Waldenburg in 1976 and *Prieur* (Fig. 12) was asked to direct it. *Pohler* (appointed as a scientific member of the AO since 1973) transferred the organization of the AOVET Secretariat to him. The Straumann Institute provided the office space for the AOVET Center, assistants, infrastructure, instruments and implants for research. *D. Prieur* became the first Executive Secretary of the AOVET organization. He prepared the official and educational meetings, coordinated and organized the increasing numbers of local and international AOVET courses.

The formation of the AOVET Center led to an increased structuring of the AOVET Organization and the spreading of veterinary operative fracture treatment. The function of the Executive Secretary provided continuity and stability. AOVET introduced an office term of two years for the elected president. But before the new president would take office, he/she would serve two years as "president-elect" and after his/her two years in office he/she would remain two years as "past-president". This latter presidential turnover rule contributed to the organizational continuity as well. In 1980, *Brinker* was the elected president as successor of *von Salis*, who held this position for over 10 years.

As new implants were developed for human fracture management, AOVET members applied them where possible also to their patients. The dynamic compression plate (DCP) succeeded the original round-hole plate and was for years the "work-horse" among the plates. Because of the developing osteoporosis and the DCPs in some human and small animal patients, the limited contact compression plate (LC-DCP) was invented. The LC-DCP was never in wide use in the equine field because osteoporosis under the DCP was no problem in this species. Then came the point contact fixator (PC-Fix), where only small points on either side of plate made contact with the underlying bone. After successful testing in sheep, these implants were first clinically tested in equine and bovine patients at the large Animal Clinic of the University of Zurich by *Auer* and his team. The plates were attached to the bone by means of cone-headed screws of universal lengths

Fig. 12 Dr. *Dieter Prieur* who served 16 years as Director of the AOVET Center at the *Straumann* Institute in Waldenburg. As a small animal practitioner, he mainly promoted the small animal aspect of AOVET. | *Dr. Dieter Prieur, der 16 Jahre als Direktor des AOVET-Zentrums am Straumann-Institut in Waldenburg tätig war. Als Kleintierpraktiker förderte er vor allem den Kleintieraspekt von AOVET.*

Fig. 11 Faculty picture of the AOVET Courses at the Ohio State University, Spring 2006. The equine faculty is numbered: 1, *Larry Bramlage*, Rood and Riddle Equine Clinic, Lexington Ky; 2, *Al Ruggles*, Rood and Riddle Equine Clinic, Lexington, USA; 3, C. *Wayne McIllwraith,* Colorado State University, Fort Collins, USA; 4, *Dean Richardson*, New Bolton Center, University of Pennsylvania, Kennett Square, USA; 5, *Jörg Auer*, Executive Secretary AOVET, University of Zurich, Zurich, Switzerland. 6, *Robert Schneider*, Washington State University, Pullman; USA, and *Jeffrey Watkins*, Texas A&M University, College Station, USA. The rest are small animal faculty. | *Fakultätsbild der AOVET-Kurse an der Ohio State University, Frühjahr 2006. Die Pferdefakultät ist nummeriert: 1, Larry Bramlage, Rood and Riddle Equine Clinic, Lexington Ky; 2, Al Ruggles, Rood and Riddle Equine Clinic, Lexington, USA; 3, C Wayne McIllwraith, Colorado State University, Fort Collins, USA; 4, Dean Richardson, New Bolton Center, University of Pennsylvania, Kennett Square, USA; 5, Jörg Auer, Vorstandssekretär AOVET, University of Zurich, Zürich, Schweiz. 6, Robert Schneider, Washington State University, Pullman; USA, und Jeffrey Watkins, Texas A& Universität, College Station, USA. Der Rest ist Kleintier-Fakultät.*

(26 mm) at a predetermined angle and locked in the plate hole through press-fitting. After defining some shortcomings and improvements, a smaller PC-Fix II for 3.5 mm screws was developed and clinically tested at the Small Animal Clinic of the University of Zurich. The plate was subsequently applied in human humeral fractures, but never reached wide use, as by the locking compression plate (LCP) gained on universal popularity. In the LCP implant, the screw head contained double threads, which fitted perfectly into corresponding threads in the plate hole and provided superior stability. This was greatly appreciated by the equine orthopedic surgeons, who adopted it almost immediately.

The veterinarians changed the design of their LCP's such that they incorporated a stacked locking hole on one side of the plate associated with a round edge instead of the tapered and pointed end, as seen in the human plates. This allowed insertion of locking head screws closer to the articular margin without having the tapered end protruding over the joint margin (Fig. 13).

The increasing emphasis placed by the AO on atraumatic operation techniques and "biological" osteosynthesis concepts as expressed by *Perren* (*Müller* et al. 1991, *Perren* 1991), found particular interest by the AOVET members.

Minimally invasive osteosynthesis techniques also gained popularity among the AOVET members. However, these techniques are easier to apply in small animal surgery than in equine patients.

Movement of the AOVET center from Waldenburg to Zurich

After the untimely death of *Fritz Straumann* in 1988, the support of the veterinarians in Waldenburg was continued by *Thomas Straumann* (the son of *Fritz*) and *Pohler*. But after the management buyout by *Ruedi Maag*, the AOVET support in Waldenburg stopped. So, it was a logical decision when *Prieur* retired as Executive Secretary of AOVET and director of the AOVET Center at the end of 1991 that the AOVET Center was moved from Waldenburg to the Veterinary Surgery Clinic at the University of Zurich, which was directed by *Auer*, who returned in 1989 from the United States to take over the vacant position as Professor of Veterinary Surgery. The decision by *Auer* to return to his alma mater was also supported by the desire to be more involved with the AO Foundation, a wish that became true shortly after his arrival in Switzerland. He was elected as successor of *Prieur*. The leadership of the

Fig. 13 The locking compression plate modified by AOVET. One end has a rounded contour with a round stacked combi hole allowing insertion of either a regular screw or a locking head screw, instead of a tapered, pointed end on both sides as used in the human plate. | *Die Verriegelungskompressionsplatte modifiziert durch AOVET. Ein Ende hat eine abgerundete Kontur mit einem runden gestapelten Kombi-Loch, das das Einsetzen einer normalen Schraube oder einer Verriegelungskopfschraube ermöglicht, anstelle eines konischen, spitzen Endes auf beiden Seiten, wie es bei der menschlichen Platte verwendet wird.*

AO Foundation greatly appreciated the fact that the AOVET Center was strongly supported by the head of a Swiss University Clinic and offered generous financial support, which included the employment of a secretary for AOVET at the executive secretary level. From the beginning it was understood that working at the AOVET Center did not keep the secretary 100% busy and that she could accept work related to other business deemed appropriate by *Auer*, while being paid fully by the AO Foundation. This was looked at as a win-win situation, by having AOVET affiliated with an academic institution and that institution profiting some from the AO Foundation. Full financial responsibility of AOVET through the AO Foundation, which started on January 1, 1992 with the move to Zurich, occurred through the AOVET Center. Therefore, the Executive Secretary and his secretary turned in the budget and allocated all the funds. The AOVET Association itself was only responsible for the money gathered through the yearly membership fees. These funds were accumulated unless a special cause had to be supported as proposed by the AOVET Board and voted on by the membership. The AOVET Center team got involved in the organization of AOVET courses, first mainly in Europe. With time, yearly courses were organized in France, Italy, Austria, and Germany. Other countries followed and these arrangements were continued after the move of the AOVET Center to Zurich. The courses offered in Columbus were accepted into the yearly course plan of AOVET and slowly the course offers expanded also to Latin America and Asia Pacific.

AOVET members and the AO foundation

With time more and more AOVET members were introduced to the Board of Trustees of the AO Foundation. From initially only the AOVET President, membership of the AO Foundation Board of Trustees was expanded to the President-Elect, the Past President and eventually to Chairpersons of the various AOVET boards, which resulted in better visibility and better acceptance of this "fledgling" but "oldest" specialty within the AO Foundation. At the Trustee Meeting in Chicago in 2009,

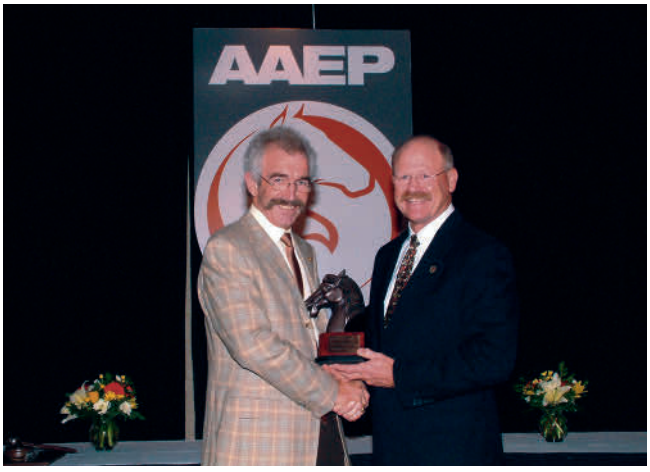

Fig. 14 Dr. *Thomas Lenz*, President AAEP presents the "AAEP Distinguished Educator Award" to Prof Jörg Auer, Executive Secretary AOVET in 2003. | *Dr. Thomas Lenz, Präsident der AAEP überreicht 2003 den „AAEP Distinguished Educator Award" an Prof. Jörg Auer, Exekutivsekretär der AOVET.*

AOVET was officially voted in as one of the four AO Foundation Specialties at the side of AOTRAUMA, AOSPINE, and AOCMF. These Bylaws contained a sentence that the Chairmen of the Specialties were members of the Board of Directors (AOVA = AO Verwaltungsausschuss) and Dr. *Jean-Pierre Cabassu*, Chairman of AOVET, a small animal practitioner from Marseille France, became the first AOVET member of the AOVA. He fulfilled his term on the AOVA very successfully and earned the full respect of his fellow AOVA members.

Being accepted as an equal specialty led to a complete restructuring of AOVET according to the guidelines established in the other specialty groups and to a substantial increase in the yearly budget.

Through the years, the victory march of osteosynthesis has gained access to all major University Veterinary Clinics in Europe, North and South America, Australia, New Zealand and many Asian and African countries, as well as all progressive equine clinics across the world. Equine basic and master courses are now organized on a regular basis in Europe and the USA. These courses are regularly also frequented by equine surgeons from other continents.

The American Association of Equine Practitioners recognized the efforts the equine AOVET members in advancing equine fracture management with the "AAEP Distinguished Educator Award". *Auer* of the university of Zurich, Switzerland, who served as the Executive Secretary of AOVET at that time could accept the award on behalf of AOVET during AAEP's Annual Meeting in 2003 (Fig. 14).

Dr. *Dean Richards*on of the University of Pennsylvania, New Bolton Center (see Fig. 13), has gained international recognition as one of the main leaders in equine fracture management together with the previously mentioned *Bramlage* and *Ruggles* of Rood and Riddle Equine Specialty Clinic in Lexington, USA. Other leaders in the field that should be mentioned are: *Jeffrey Watkins* of Texas A&M University, USA (see Fig. 13); the late *Alan Nixon* of Cornell University, New York; Prof. *Christophe Lischer* of the University of Berlin, Germany; Prof. *Anton Fürst* of the University of Zurich, Switzerland; and *Fabrice Rossignol*, Clinique Gros Bois, France. These are the ones that carry the load to expand the development of equine fracture management by AOVET into the future.

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