



## In Memoriam : Robert Danis, an inspiration for Maurice Müller and origins of the AO Foundation

Jan DAUWE, Stefaan NIJS, Boyko GUEORGUIEV, R. GEOFF RICHARDS

*From the UZ Leuven, Orthopaedic Surgery, Leuven, Belgium*

**Robert Danis (1880-1962) was a Belgian general surgeon mostly remembered for his contributions in the field of bone and joint surgery, a medical subdiscipline currently known as orthopaedic trauma surgery. He initiated this with his first book (1) on the subject in 1932. Danis was the first to develop a concept for biomechanically stable internal fracture fixation, creating and producing his own screws and plates with self-developed machine tools. In 1938 he produced a steel plate with screws that exerted axial compression during use. A device known as the “coapteur”. By 1949 he had reported on 1500 clinical cases. His surgical technique with bone fragment repositioning and plate fixation allowed early movement and rehabilitation, one of the four main principles of the AO/ASIF [Arbeitsgemeinschaft für Osteosynthesefragen/Association for the Study of Internal Fixation] which is the AO Foundation today. Danis’ clinical and scientific work caught the attention of Maurice Müller, a swiss surgeon and researcher, who was the originator of the AO/ASIF and one of its founders later on. Both surgeons met personally in Brussels in 1950.**

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Robert Danis was born the 28<sup>th</sup> of October in 1880 in Oudenaarde, Flanders, Belgium. He graduated from medical school in 1904 at the University of Brussels in the capital of Belgium. As a resident

in surgical training, he was primarily interested in thoracic and vascular surgery (2). In 1912 he presented his thesis about vascular anastomoses and ligatures. However, Danis was a man with many interests. At that time, general anaesthesia was performed with ether or chloroform which was a highly risky procedure for the patient. So, he focussed on the field of local and regional anaesthesia and became an expert in the use of cocaine and novocaine for loco-regional blocks in numerous body parts (e.g. sacral block) (3). Since he mastered these regional anaesthetic procedures, he was able to accomplish a series of surgical procedures in the outpatient clinic Hospice de L’Infirmier. This hospital was known to be the first one-day clinic in Belgium. Danis performed hernia repairs, mastectomies, thyroidectomies, even hysterectomies and managed to send the patient home the same day of the surgery (2).

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- Jan Dauwe<sup>1,2</sup>,
  - Stefaan Nijs<sup>3</sup>,
  - Boyko Gueorguiev<sup>1</sup>,
  - R. Geoff Richards<sup>1</sup>

<sup>1</sup>AO Research Institute Davos, Switzerland.

<sup>2</sup>Department of Orthopaedics, University Hospitals Leuven, Leuven, Belgium.

<sup>3</sup>Department of Traumatology, University Hospitals Leuven, Leuven, Belgium.

Correspondence : Dr Jan Dauwe, AO Research Institute Davos, Clavadelstrasse 8, Davos, Switzerland.

E-mail : dauwejan@gmail.com

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In 1925, Robert Danis succeeded Antoine Depage and became chairman of the surgical department at the Brugmann Hospital in Brussels. There, Danis and his colleagues at the surgical department dealt with various trauma cases including bone fractures. The advantages of surgical treatment of bone fractures had been known and described by Albin Lambotte. Lambotte (1866-1955) was a Belgian surgeon and a solo pioneer in the field of bone surgery. He was the first to use the word “*Osteosynthèse*” or osteosynthesis in his work *Chirurgie opératoire des fractures* in 1913. This particular term is derived from the Greek words *osteo* which means bone and *synthesis* meaning combining separate elements to a unified entity. Osteosynthesis refers to internal fixation of a bony fracture with plates, screws, stainless steel wire and other metal devices in order to restore the anatomy and induce fracture healing (4). Surgical management of bone fractures by osteosynthesis allows the patient to rehabilitate early and therefore regain function and range of motion. This early movement is one of the four main principles of the AO [Arbeitsgemeinschaft für Osteosynthesefragen] later on (5). Nevertheless, most surgeons in the late 1920s feared open fracture treatment because of the risk for infection.

Robert Danis was a strong believer of operative fracture treatment and early mobilization. To prevent infection, he endeavoured a strict non-touch principle and demanded an iron discipline in the operation theatre (6). He protected his osteosynthesis postoperatively with a light external bandage made of metallic fabric coated with celluloid. The joints were not immobilized allowing mobilisation (2).

In 1938, he invented the “Coaptateur de Danis”, a device used to attain interfragmentary compression and absolute stability between two bony fragments. On X-ray, bone healing was achieved under continuous compression without visible callus formation. Danis published these results and findings in his book *Théorie et Pratique de l'ostéosynthese* (7) in 1949. This particular book caught the attention of Maurice E. Müller, a Swiss surgeon born in Biel in 1918. While visiting Professor Van Nes, who believed that successful surgeons should develop their own instruments, Müller was recommended to visit Danis. He visited Robert Danis in Brussels for

only one day in March 1950 to review some cases together.

“I realized that I was witnessing a method of osteosynthesis which allowed one to operate without having to resort to plaster as supplemental fixation. I had never seen this before and had never understood that this was possible. I was always convinced, that many of the complications of fractures, like terrible stiffness, were the result of immobilization” (8,9).

Danis informed Müller that he followed Lambotte's ideas for the past 25 years, though like Lambotte he worked alone. The two surgeons got along very well. Müller found himself confronted with thirty different brands of whisky. He wrote: “We discussed his work and his book, whilst liberally sampling this Scotch repertoire. It was with extreme difficulty that I found my hotel room at 4 o'clock the next morning” (2,10). Unfortunately, Danis did not have a broader impact since he practiced solo and his writings were all in French.

Müller noted (9) “The visit to Danis was unquestionably a turning point in my thinking, but I could see immediately that there were some things that could be done better. I began immediately to think of how to improve things. Nevertheless, stable osteosynthesis, as I had seen at Danis' hospital, would become the underlying principle.” He also noted “When I visited Danis, I saw that he was alone, that he had no supporters, and was not able to do any research since he had to fund everything out of his own pocket. I realized that one first had to have a team and second, one had to have funding.”

In 1958, Müller founded the Arbeitsgemeinschaft für Osteosynthesefragen/Association of Study for Internal Fixation [AO/ASIF] together with colleagues Robert Schneider, Hans Willenegger, Martin Allgöwer and Walter Bandi (11). Additionally, Müller showed the importance of detailed full documentation which became an additional cornerstone of AO. The objective of the group was to come together to champion revolutionary techniques of internal fixation that achieved unprecedented results in healing bone fractures. Müller later declared that Danis' 1949 publication was one of the most influential works he had read and a good deal of Müller's initial development in fracture treatment can be traced back to that day in 1950 in Brussels.

The AO founders searched for a suitable place to conduct their research to meet their objectives. In 1959, Davos (Switzerland) was selected as primary location with Allgöwer as first director, followed by Herbert Fleisch (1963-1967), Stephan Perren (1967-1996), Erich Schneider (1996-2008) and Geoff Richards since 2009 (5). From June 1992 until now, this research facility is known as the AO Research Institute (ARI) Davos. Visitors to the AO Research Institute Davos pass several images commending the predecessors of the AO's approach to fracture repair. Two of these pictures are devoted to the Belgian surgeons Albin Lambotte (1866-1955) and Robert Danis (1880-1962). A description of their contributions can be found in Urs Heim's book *Das Phänomen AO* (12).

Finally, again we quote Maurice Müller (9) "I kept thinking of Danis, who was so much ahead of his time with his concepts of stable osteosynthesis, and yet was not able to accomplish much because he worked alone. Danis' failure to be influential sparked in me the realization that I would succeed in establishing a new school of surgery only if I were able to surround myself with an enthusiastic and devoted team." This is how the AO started from the inspiration of Robert Danis.

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