

# JOSÉ MARÍA CAÑADELL I CARAFÍ CAÑADELL TECHNIQUE

## The eponym

**Cañadell technique.** A surgical procedure used on malignant tumours in long bones in children, consisting of physeal distraction, tumour excision preserving the epiphysis, and replacement of the extracted tissue with a bone graft. It avoids amputation of the limb while achieving a high cure rate, often preserving the functionality of the affected limb<sup>1</sup>.



José María Cañadell  
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## José María Cañadell i Carafí (1923-2014)

José María Cañadell i Carafí was born in Barcelona in 1923. He graduated in medicine in 1946 and worked in Prof. Piulachs' department<sup>2</sup>, where he specialised in traumatology. He would later work at the *Hospital del Sagrat Cor*, in the Department of Orthopaedic Surgery and Traumatology, then headed by Santos Palazzi, where he remained for six years. During that time he undertook specialisation internships at the Tuscan Orthopaedic Institute in Italy. In 1953, he joined the *Hospital de la Creu Roja* as head of the Department of Orthopaedic Surgery and Rehabilitation, focused especially on paediatric orthopaedics. He was appointed assistant director five years later. The previous year, his qualifications as a specialist in orthopaedic surgery and traumatology were recognised. He earned his doctorate in 1966 with the thesis *Verificación de los factores locales que influyen en la actividad del cartílago de crecimiento*<sup>3</sup> (*Verification of the local factors that influence the activity of growth cartilage*).

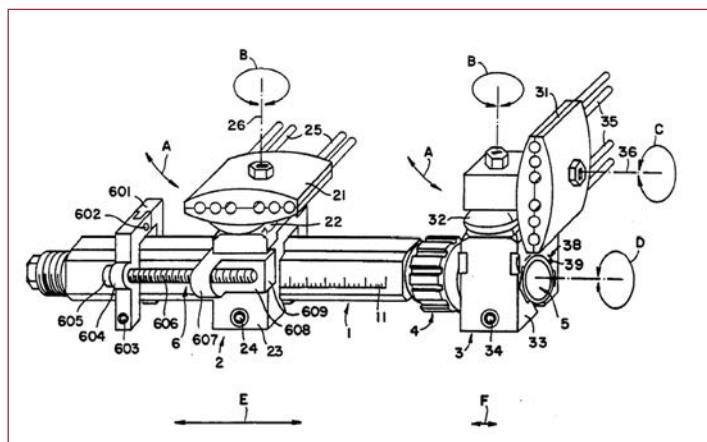
In 1968, he took the decision that would determine the course of his professional career when he accepted the post of permanent professor and director of the Department of Orthopaedic Surgery and Traumatology at the *Clinica Universidad de Navarra*<sup>4</sup>. The decision was not easy, since Cañadell was giving up a comfortable professional situation to take on a new challenge, albeit an exciting and potentially significant one. Time would show he had made the right choice.

At the *Universidad de Navarra* there was much to be done. Created in 1952, it opened its faculty of medicine two years later, but from the consulting standpoint it began its activities in 1962 with the opening of the first phase of a 19-bed clinic. Shortly afterwards, work began on the second phase, increasing its capacity to 200 beds; the expanded clinic opened in 1969<sup>5</sup>. That was when Cañadell was invited to join the team, to

lead the new department of orthopaedic surgery and traumatology. In the following years, Cañadell took on extensive academic responsibilites. He was appointed full professor and director of the clinic in 1968, the latter post one he would occupy until 1989. These years coincided with the centre becoming recognised as a first-class consulting and research institution. He was also vice dean of the Faculty of Medicine<sup>3</sup>.

During this entire period, Cañadell's activity was ceaseless. He edited over 20 books and monographs, directed or co-directed 35 doctoral theses, and participated in numerous meetings in his specialty. His innovative activity also led him to design, jointly with Juan Lazo de Zbikowski an external fixator for which he even obtained a patent in the USA<sup>6</sup>; the device was marketed by the company Stryker Howmedica. In 2009, he published, with Mikel San Julián, the book *Pediatric bone sarcomas: Epiphysiolytic before excision*, compiling his extensive experience in treating these bone tumours.

He was president of the *Societat Catalana de Cirurgia Ortopèdica i Traumatologia* (1964-1966), the *Sociedad Española de Cirugía*



External fixator with “controllable damping”, invented by Cañadell and Lazo<sup>6</sup>

*Ortopédica y Traumatología* (1970-1972), the *Sociedad Española para el Estudio de la Osteosíntesis* (1972-1981), the AO Foundation (1972-1981), and the European Paediatric Orthopaedic Society (1993-1995). He was an honorary member of the *Sociedad Española de Microcirugía*, the *Sociedad Andaluza de Cirugía Ortopédica y Traumatología* and the *Asociación Española de Medicina y Cirugía del Pie* among others. He was a founding member of the European Musculo-Skeletal Oncology Society. Outside Europe, he was an honorary member of the societies of Orthopaedic Surgery and Traumatology of Venezuela, Chile, and Argentina, as well as of the *Asociación Médica Argentina*. He was awarded the Gold Medal of the Spanish Red Cross (1968) and the Gold Medal of the *Universidad de Navarra* (1997). His achievements were also recognised in 2006 when he was nominated honorary president of the 43th Congress of the Society of Orthopaedic Surgery and Traumatology, held in Barcelona<sup>4</sup>. In 2008, he was named honorary president of the European Federation of National Associations of Orthopaedics and Traumatology (EFORT).

After retirement, Cañadell continued to live in Pamplona, where he had arrived over 40 years before. He continued to visit the *Clínica*, where he was affectionately acknowledged for his contributions to making it a medical centre of reference. He died on 19 March 2014 in Pamplona.

## Cañadell technique

Until the 1970s, primary malignant bone tumours in children, especially osteosarcoma and Ewing sarcoma, had an extremely poor prognosis. Early metastases meant that amputation of the limb for tumours in leg bones had virtually no effect on survival, which was 12 to 18 months after diagnosis. At that time Cañadell considered that amputations were of little value to treat the disease, since he observed practically no



José María Cañadell i Carafí (right), and Mikel San Julián Aranguren (left), presenting the book they co-edited, *Pediatric bone sarcomas: epiphysiolytic before excision*. Pamplona, 2009

improvement in the prognosis and outcomes were so poor<sup>7</sup>. This all changed with the application of chemotherapy.

When chemotherapeutic treatment began to be employed to treat childhood osteosarcoma, it became possible to halt systemic dissemination and improve survival. Cañadell challenged traditional thinking regarding limb amputation, proposing to undertake conservative surgery excising the bone tumour, generally located in the diaphysis, while conserving the rest of the limb. This option was not universally accepted at first, and Cañadell was berated at international meetings for his willingness to assume the risk of avoiding amputation, the unanimously accepted treatment at that time<sup>7</sup>. Cañadell was convinced that the problem of the disease was not the primary tumour but dissemination, especially pulmonary metastases. In this sense, he defended the concept, which was slowly gaining ground, that cancer was in fact a disease that had to be treated systemically and that excising the tumour was just one part of the treatment.

If chemotherapy improved the prognosis, was there a difference between limb amputation and excision of the tumour? Cañadell believed there was not. Furthermore, he thought excision might be able to

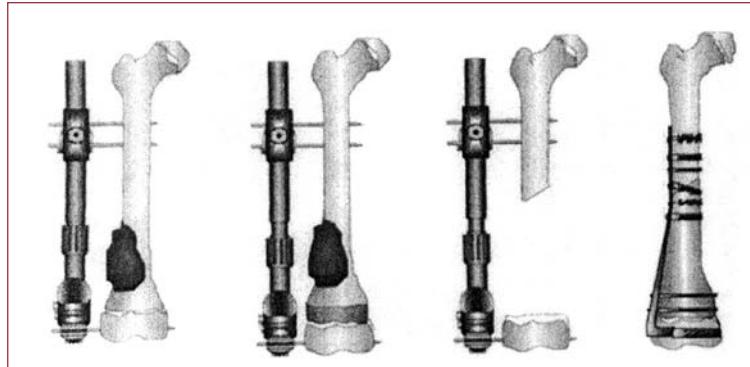
maintain the functionality of the limb –an especially important factor in children. These premises led Cañadell to devise his technique.

In July 1984, his surgical team first used his new technique to operate on a first child<sup>7</sup> with an osteosarcoma, and the following month they used it for the second time, on a child with an osteoblastic osteosarcoma. Both children were alive in 1994 when Cañadell published his article explaining the technique in detail and the results of the first eight operations<sup>1</sup>. First, he recommended that it should only be applied when the tumour was located in the metaphysis, when the epiphyseal cartilage can be opened and the tumour did not invade it. The latter was an important point, ensuring that the cartilage could be kept completely free of disease with absolute certainty. Cañadell verified this with all the methods at his disposal: radiology, angiography, CT scans, magnetic resonance imaging, and histological examination.

Once the decision to excise the tumour is taken, the technique is applied as follows. First, two needles are positioned in the epiphysis and in the diaphysis, the latter 8 cm to 10 cm above the tumour. Then the needles are connected to a retractor, and progressive distraction is begun until a 2 cm opening is achieved. This procedure takes nearly 15 days and is carried out while the patient is undergoing chemotherapy. The second phase consists of excising the entire tumour in a single piece with wide margins yet without touching the epiphysis or its cartilage. The third phase starts after histological confirmation that the margins of the surgical specimen are free of tumour. Then a bone graft is inserted. When the epiphysis is affected, it is resected and the limb is rebuilt using other methods, which might include a prosthesis or arthrodesis<sup>1</sup>.

In his first article<sup>1</sup>, Cañadell reported a series of 20 patients with a mean follow-up of 54 months. Only one case had recurred and only three patients had died from pulmonary metastases. So the survival rate was 85%; the function of the affected limb was deemed good or excellent in

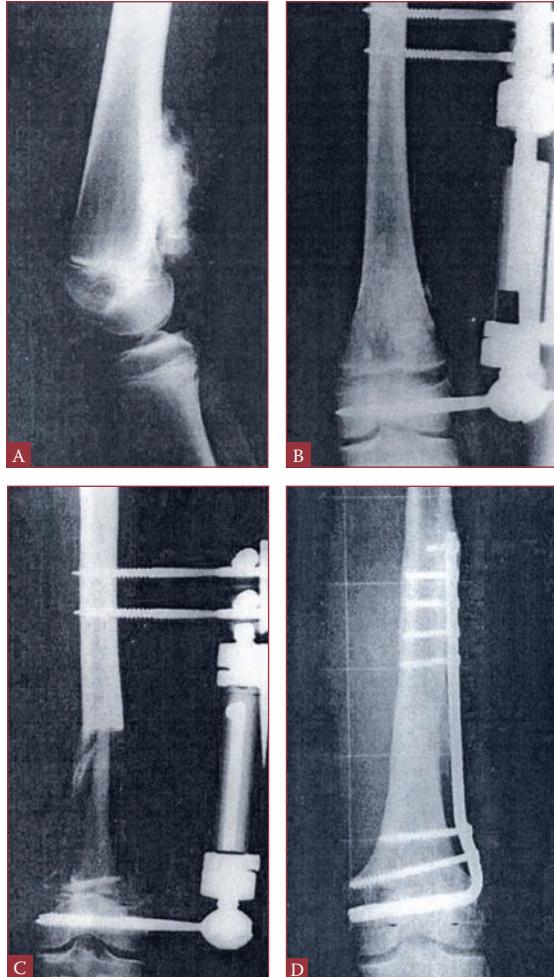
Representation of the various stages of Cañadell technique, in this case on a tumour in the femur<sup>1</sup>



half the patients. The huge contribution of Cañadell's technique was to avoid amputation and conserve the epiphysis with its cartilage, enabling the preservation of the joint's functionality. As he wrote in his article<sup>1</sup>:

"When resecting a tumour, the surgeon must be certain that no malignant tissue is left behind and most authors agree that a 5 cm margin is safe. This means that, when the tumour is in the metaphysis, resection requires the loss of the adjacent joint. Our technique, using previous physeal distraction, avoids the loss of the epiphysis. We believe that when the growth cartilage is present, a margin of safety is provided by the cartilage itself and that the 5 cm margin suggested by most authors may in fact be unnecessary. The view is supported by the fact that no tumour recurred locally in the retained epiphyses."

Twenty years after the first operation, Mikel San Julián and his group, who have continued Cañadell's work in surgical treatment of bone tumours, published a review of their experience<sup>8</sup>. In the article, they described the application of the technique in 40 children under 10 years old with osteosarcoma or Ewing sarcoma who were monitored for 5 to 19 years. The survival rate was 75% and functional recovery was deemed good or excellent in 70% of cases. Twenty years of experience allowed



X-rays showing an osteosarcoma in a 14-year-old boy: (A) before treatment, (B) after epiphyseal distraction, (C) resection of the tumour and graft from the contralateral tibia, and (D) eight years after the operation<sup>1</sup>

them to conclude: "Limb salvage is a real possibility even in young children with bone sarcomas". Cañadell technique has meant that, for many children and their families, bone cancer has become a nightmare that will end, often enabling them to go on to lead a nearly normal life.

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## Further reading

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