Introduction
What exactly is chaos? The name “chaos theory” comes from the fact that the systems that the theory describes are apparently disordered, but chaos theory is really about finding the underlying order in apparently random data.

Why Scoliosis and Chaos? The scoliosis is the concrete materialization of the chaos theory applied to the spine.

The system is:
open (Verticality allows exchange with the outside) that is to say the transition from a closed kinetic chain to an open kinetic chain. The head is on balance on the spine which gets closer to the gravity line. The dynamic system has become, opened, balanced.

Sensitive to Initial Conditions states that a small occurrence can cause large-scale changes. The apple falls according to the gravitation law of Newton, and we can foresee the place of the fall. The tree leaf falls according to the same laws, but we can not foresee the exact place of the fall, because it is more sensitive to the wind.

The unpredictability of such phenomena leads to highly sensitive to initial conditions, it is the deterministic chaos. We are now unable to predict the evolutivity of a scoliosis under 25° of Cobb magnitude.
**Complex** (multifactorial)

The experimental study of scoliosis and the etiologic research about scoliosis demonstrate that many factors can provoke a scoliosis: bony factor, muscular, ligament, neurologic, metabolic, chemical and postural...

We admit that a scoliosis is a multifactorial disease, but we have never demonstrated that the accumulation of lots of those factors can lead to a scoliosis. The linear transposition is deceiving. The chaotic transposition is logic.

**Discontinuous** (thresholds)

The easiest threshold to understand is the biomechanic one:

Let’s imagine a movement of the anterior flexion of the trunk and let’s look at what is happening at the level of the apical vertebra of the scoliosis. For a rotation under 25°, the lever arms of the concave and convex muscle are around the rotation centre of the vertebral body and enable a stability of the spine. At this step all the muscular activity lead to a correction of the scoliosis.

**Patternable** (4th fractal dimension)

With the development of the 3D many models have been described using bony elements and then muscular and ligaments. Many classifications such as the one of Stagnara, SRS, King, Lenke enable to group the different scoliosis according to different criteria.
Deterministic

The scoliosis is not a lottery. It can be considered in fact as deterministic in what seems random. Even if we cannot rely on any characteristic of the progressive idiopathic scoliosis when they are used to predict the progression, we find afterwards some characteristic disturbances:

- late maturation of the postural system,
- Dysplasia signs of the abnormal laxity of the tissues...

Strange Attractor

Chaotic motion gives rise to what are known as strange attractors, attractors that can have great detail and complexity. Strange attractors occur in both continuous dynamical systems. The Strange Attractor can take an infinite number of different forms. All of them are fractal and demonstrate infinite self similarity. The spine oscillates permanently between pelvic and scapular girdle. The scoliosis is the graphic representation of the strange attractor which modifies the resultant of all the movements of the spine during the day.

Why is chaos theory useful to the clinician?

When the mum shows us her 11 yr old daughter with a scoliosis of 15°:

- we can reassure the mum wrongly and re-examine the child one yr later with a scoliosis of 30°. The mum will always reproach us for not having treated it with 15° and our ignorance is obvious.

- we can worry the mum by predicting a brace and re-examine the child one yr later with the same angulation of scoliosis which will not vary, our ignorance will be quite as obvious.
- we can explain to the mum that the evolution of the scoliosis under 25° is chaotic, like an earthquake, and that we must control this scoliosis with precise intervals.

We can also say that physiotherapy cannot prevent the earthquake, but constitutes an antiseismic construction which will limit the damage.

Generally, the parents know much more the theory of chaos than the physicians. Our ignorance is a little less obvious.