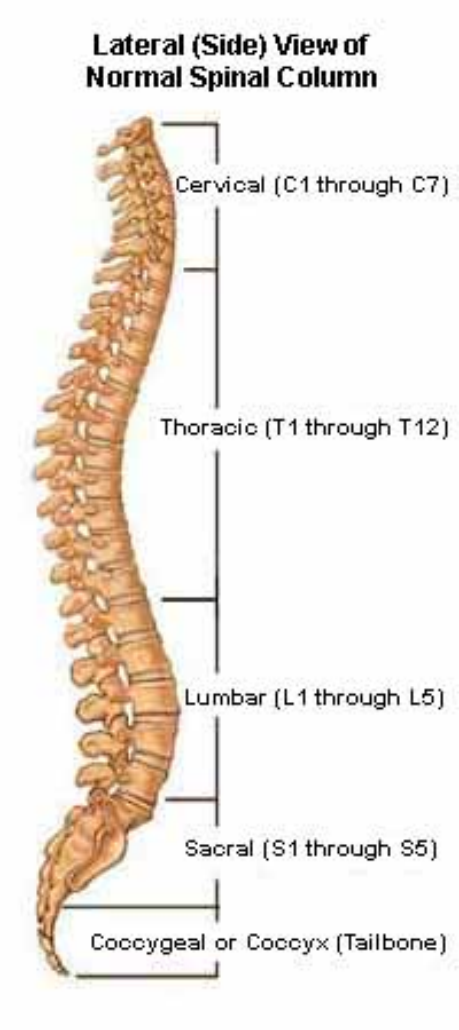
Spine Rhythm

Thinking...

- What do we know?

✓ Spine can not deform arbitrarily.

✓ Variational stiffness.



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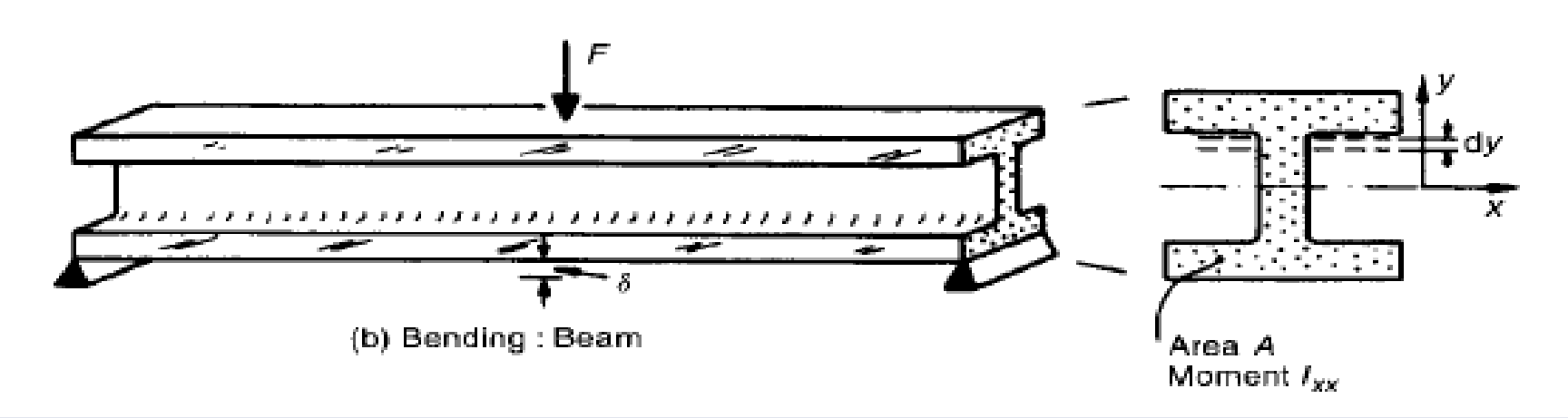
Idea!

- Beam theory seems to be a reasonable approach.



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Why Beam Analogy?

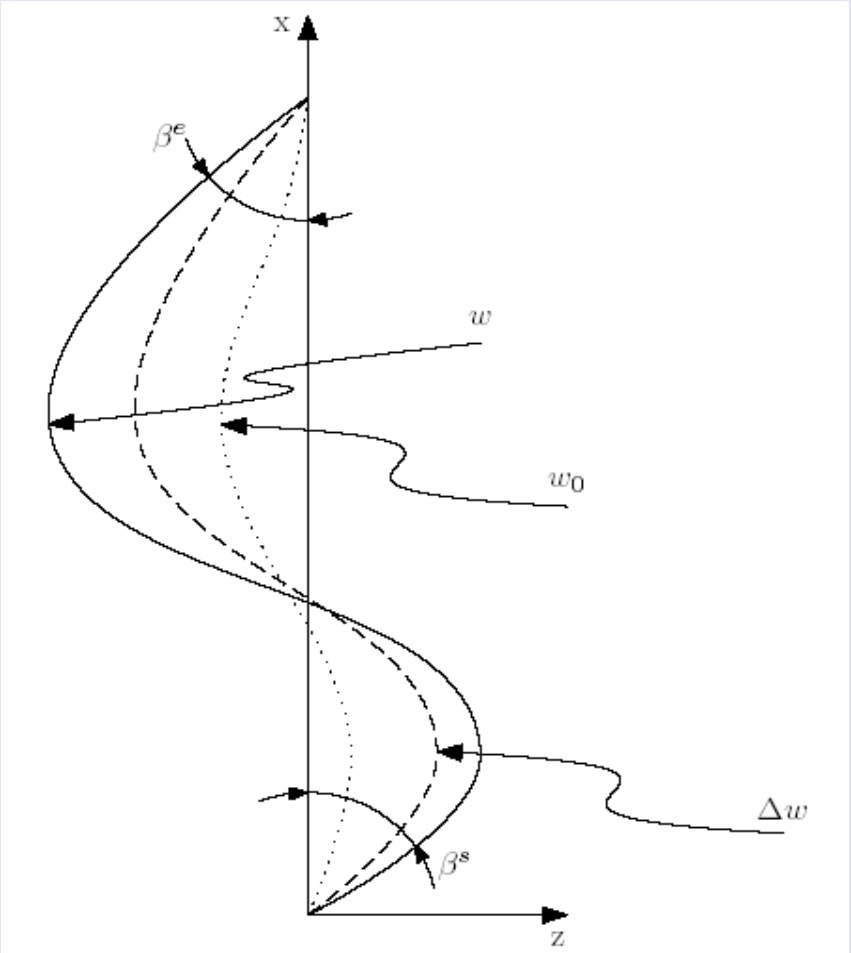
+ Fullfills our demands, physiologically reasonable. (?)

+ Mathematically easy to handle, easy to fold into a linear problem, which we need.

+ Well defined, well known within the field of mechanics.

Our Proposal – Implementation

1. Natural curvature, w_0 – standing position.
2. Changed posture – addtional, variational curve, Δw (the beam analogy).
3. Total shape given by superimposing, $w=w_0+\Delta w$.



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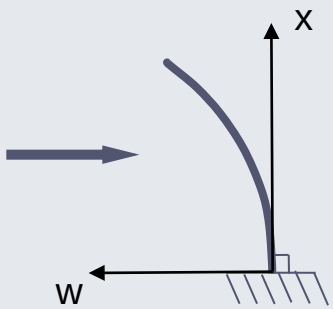
Spine Kinematics



Beam theory

$$EI\frac{d^2w}{dx^2} = -M_b$$

+

EI = const., M_b = const.

$$w(x) = a_0 + a_1 x + a_2 x^2$$

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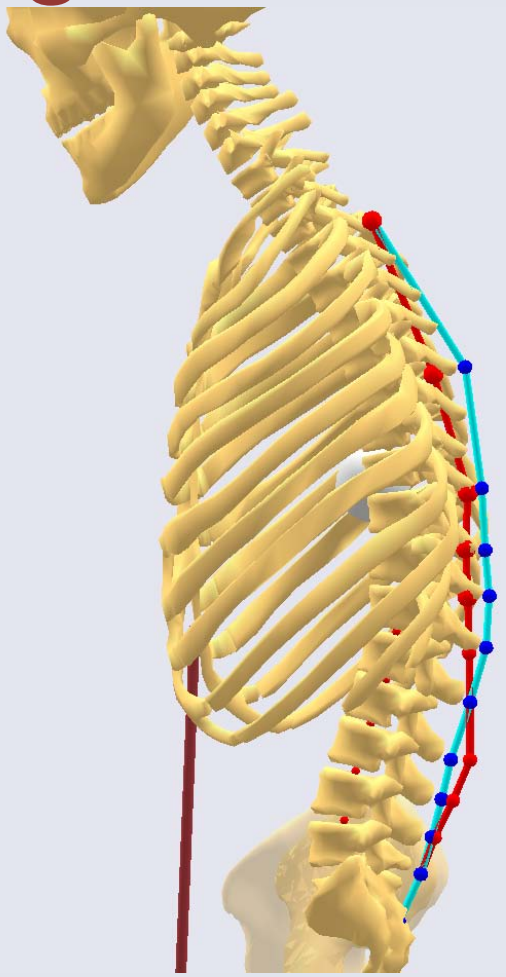
Spine rhythm experiments

Initial posture

The initial curvature of the spine in straight posture seems to be slightly different from our model, this can be seen on the picture as the difference between the two curves. To accommodate for this we have adjusted the marker position on the model manually to reflect this initial difference.

Curve spanned by ideal marker positions on model

Curve spanned by corrected ideal marker positions. The ideal marker positions has been fitted to the green curve for the initial time step.



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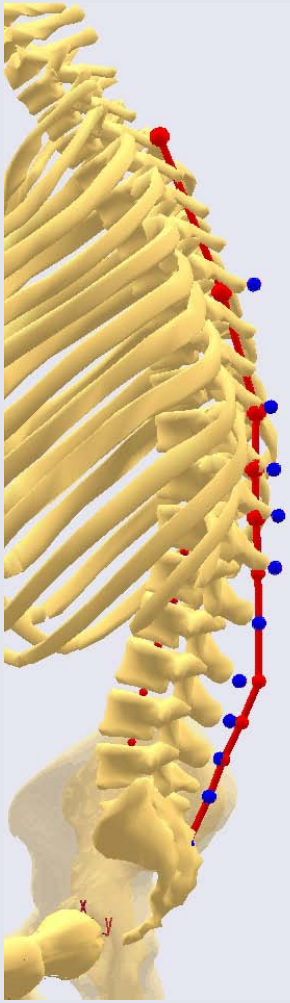
Experiment 2: backrest motion



Curve spanned by measured marker data

Curve spanned by corrected ideal marker positions. The ideal marker positions has been fitted to the green curve for the initial time step.

The motion of the model is driven using marker data for T2, L1, L4, Throcanter and the knee.

The two curves are almost identical throughout the analysis, this means that the spine rhythm of the model follows the experiment.

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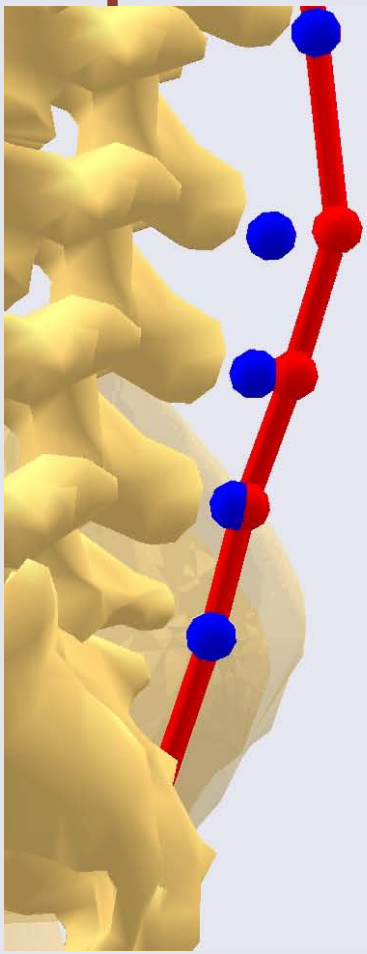
Experiment 2: backrest motion



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