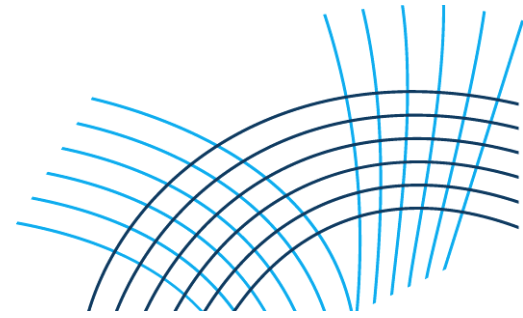




Impact of the Number of Artificial Discs on Spinal Balance

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EuroSpine 2011, October 19–21, Milan, Italy



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Freeman, Davenport,
Eur Spine J 2006

Single-level total disc replacement (TDR) in the lumbar spine is well established and usually leads to a satisfactory surgical outcome.

The success after **multi-level** TDR is, however, reported non-uniformly.*

* Tropiano et al., J Bone Joint Surg Am 2005

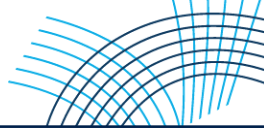
Bertragnoli et al., Spine 2005

Di Silvestre et al., Eur Spine J 2009

Siepe et al., Spine 2007



Bertagnoli and Kumar,
Eur Spine J, 2002



Artificial discs have a different kinematic behaviour than natural ones* which probably effects the spinal balance.

Spinal imbalance is known to increase the risk of spinal problems**. The aim of the study was

**to determine the effect of
the number of TDRs on spinal balance.**

* Zander et al., Clin Biom 2009

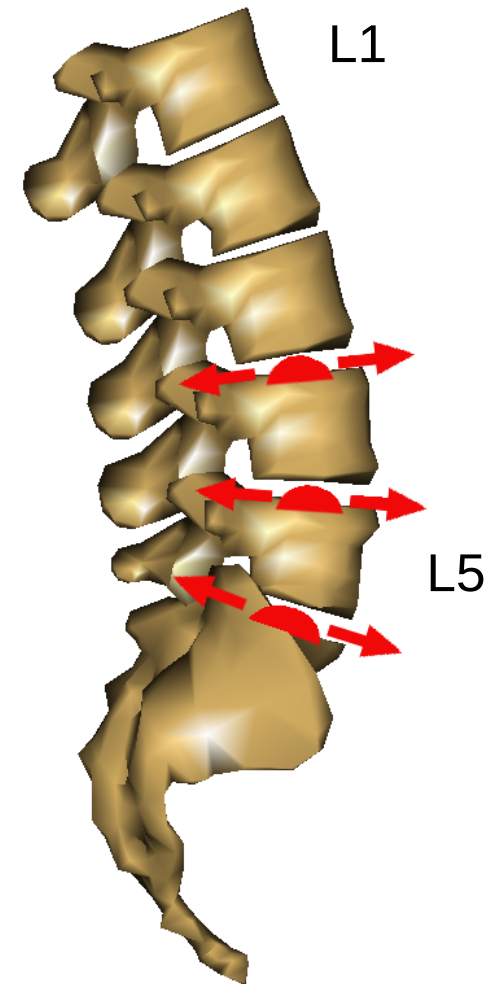
** Barrey et al, Eur Spine J 2007

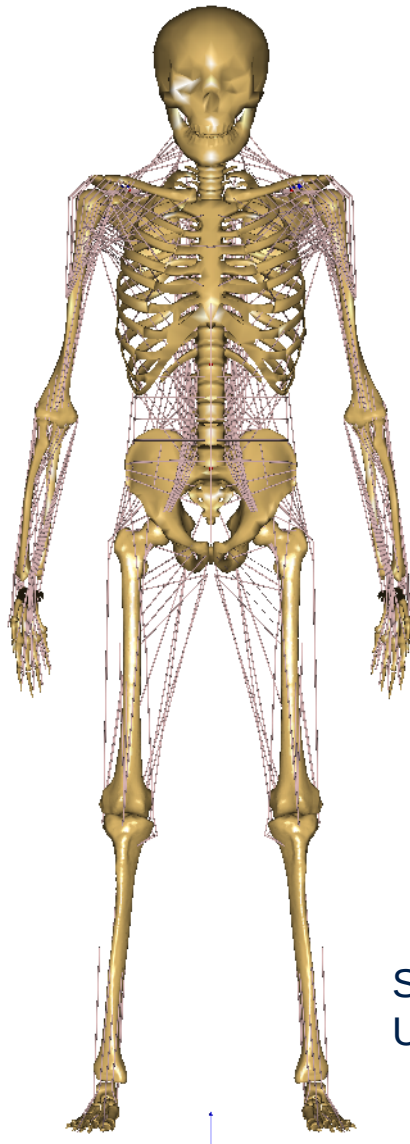
Kumar et al., Eur Spine J 2001



In 120 computer simulations the following variations were studied:

- number of implants: 1 ... 3
 - L5/S1
 - L5/S1 + L4/L5
 - L5/S1 + L4/L5 + L3/L4
- individual ap-position of implants
 - range of ± 3 mm from central position (truncated normal distribution, SD = 1 mm)





For each of the 120 configurations the spinal shape for standing was calculated.

As side condition it was assumed that there is an optimal muscle synergism.

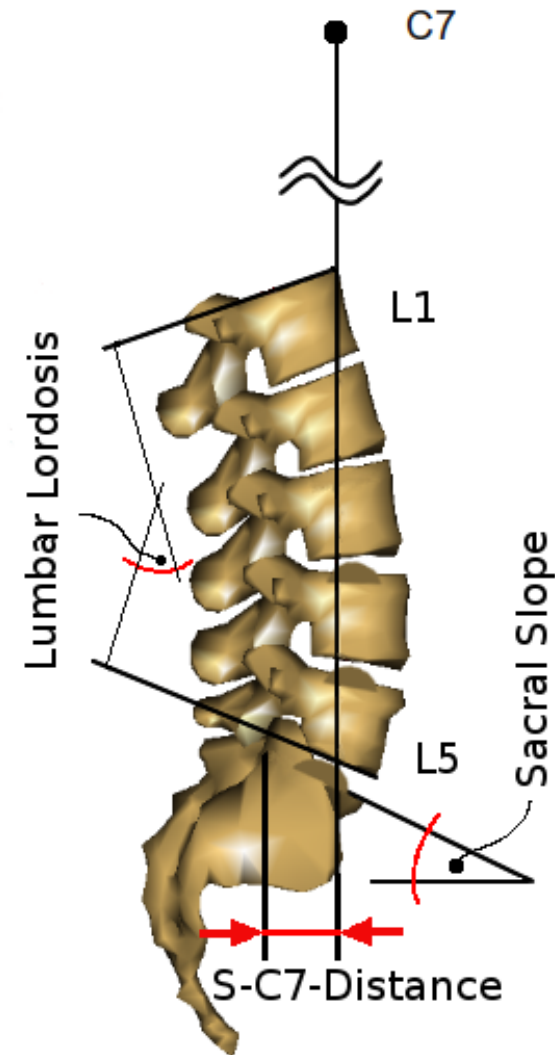
Standing Model of the AnyBody Modelling System
Usefulness was shown by

Gadomski et al, ORS, 2011,
Rasmussen et al, ISB, 2009.



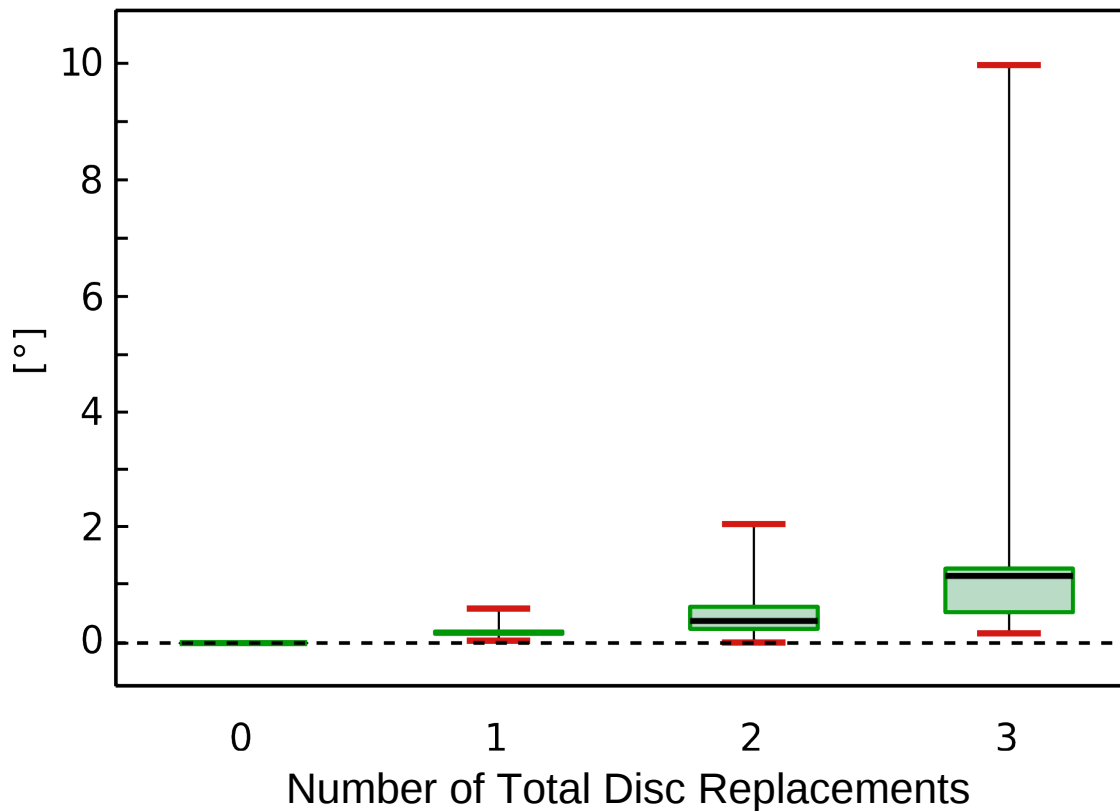
The changes of three spinal balance values due to TDR – compared to the intact situation – were evaluated:

- Sacral Slope
- Lumbar Lordosis
- Horizontal S-C7-Distance

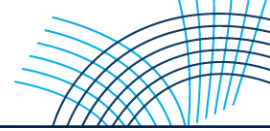




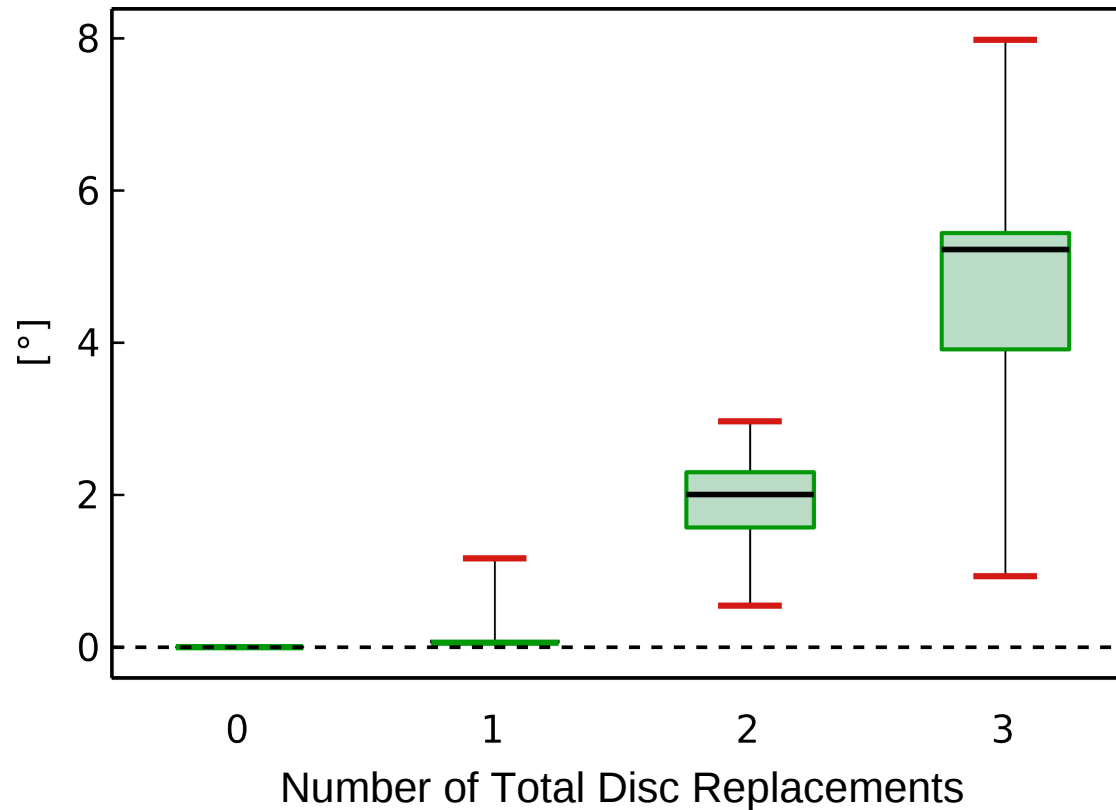
Change of Sacral Slope due to number and positions of implants



As the range considerably increases, the obtained sacral slope becomes less predictable.



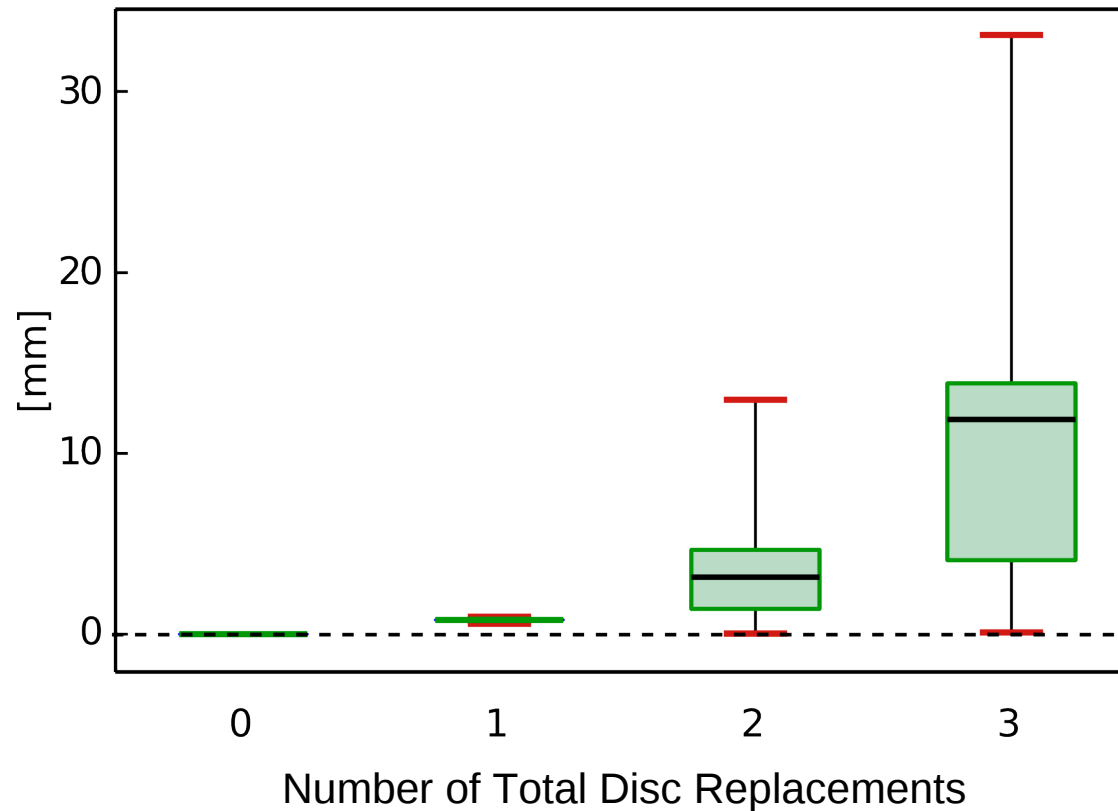
Change of Lumbar Lordosis due to number and positions of implants



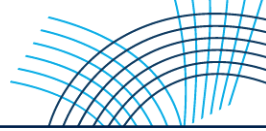
The uncertainty of the obtained lumbar lordosis increases (ranges) as well as their most probable change (medians).



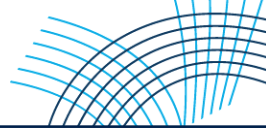
Change of Horizontal S-C7-Distance due to number and positions of implants



Again, the uncertainty of the obtained horizontal S-C7-Distance notably increases (ranges) as well as the most probable change (medians).



- Iatrogenic factors or different muscle conditions were not considered.
- The objective used to calculate the standing posture may be different.
- Relevance of the magnitude and prediction power of balance is unknown.
- Only one type of implant was investigated.



- With increasing number of TDRs, the balance is increasingly unpredictable (increasing ranges), and
- the balance will most likely change (larger medians).
- Large implant dislocations make an unfavourable balance more probable.
- However, an identification of simple geometrical parameters to completely explain the obtained spinal balance was not possible.

Thank you !

Disclosure declaration:
None of the authors has any
potential conflict of interest.

Acknowledgement:
This study was supported by

Deutsche
Forschungsgemeinschaft

DFG

