Impact of the Number of Artificial Discs on Spinal Balance

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Introduction

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
Introduction

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
Method

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)
Method

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
Usefullness was shown by

Gadomski et al, ORS, 2011,
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
Results

Change of Sacral Slope
due to number and positions of implants

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

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

- 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!

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None of the authors has any potential conflict of interest.

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