# Table of contents

**Introduction**

- 1

**Profile**

- 2

**Registries vs Randomized Controlled Trials**

- 3

**New developments**

- 4

**Application**

- 6
  - Research with Spine Tango
    - 7
  - Data entry
    - 8
  - A complete case
    - 9
  - Pre- and postoperative documentation workflow of a case
    - 10

**Statistics in Spine Tango**

- 11
  - Spine Tango growth curve
    - 12
  - Part I: Descriptive analysis form version 2011
    - 15
  - Part II: The Spine Tango Benchmarking Project
    - 38

**Participants / module analysis**

- 43

**Available questionnaires in Spine Tango**

- 45

**Publications**

- 46

---

*This annual report is digitally available in the literature section of the Spine Tango web page under http://www.eurospine.org/literature.htm. The Spine Tango security details and Code of Conduct are newly available in the same section.*
MEM Research Center

Contact:
University of Bern
Institute for Evaluative Research in Medicine
Christoph Röder, MD MPH
Stauffacherstr. 78
CH-3014 Bern
christoph.roeder@memcenter.unibe.ch
www.memcenter.unibe.ch

www.eurospine.org/spine-tango.htm
Introduction

Since the year 2000 EuroSpine - The Spine Society of Europe has been developing a registry for the documentation of surgical and non-surgical treatments in response to a growing demand for outcome measurement and quality assurance. Spine Tango is the only international spinal registry and has been developed by Eurospine and the University of Bern for this purpose. Spine Tango as an idea was proposed more than a decade ago by Dieter Grob and Max Aebi, under the auspices of SSE. There has been considerable investment of clinician, academic and financial resources to develop and improve the system. Having achieved international recognition we would like to encourage national societies and individual partners to join the registry.

The German Spine Society DWG, the largest spine society in Europe, has successfully conducted a 3-year pilot of a national spine registry using the Spine Tango technology and content as its platform. It is now planning to make documentation of all spinal interventions a mandatory prerequisite for certification as a spine center of excellence in Germany. In 2013 Polish and Belgian Spine Tango modules were launched. The Spine Society of Belgium (SSBe) has chosen the Spine Tango Registry as its national registry and will conduct a pilot study in collaboration with the National Social Insurance. In Switzerland, documentation of all spinal interventions with implants will become mandatory in 2016. Spine Tango will most likely be the system of choice to be integrated into the Swiss Implant Registry SIRIS.

Those who fund health care are already limiting access to some spinal treatments due to a lack of evidence of effectiveness. The Spine Tango registry consisting of routine data from a hospital’s daily practice allows clarity of activities and outcomes. Evidence from the registry has a lower internal (i.e. methodological) validity as compared to higher evidence studies like RCTs. But the external validity and therefore general application of our findings is what makes the dataset and its clinical and scientific findings so valuable for quality assurance, health service and outcome research.

The last three years have seen a significant increase in data entry and a consequent rise in the number of presentations related to this. Benchmark studies on specific issues like spinal stenosis and degenerative spondylolisthesis have been carried out and are further refined.

The Spine Tango registry has also reached new levels of technological sophistication. A first large spine center in Italy is programming a direct interface for data entry from their clinic information system into the Tango database. Further, an interface to the Surgimap measurement system for spinal deformities was developed for the German Spine Society’s deformity group and can soon also be used for Spine Tango.

Surgeon level data reporting is now a reality in the United Kingdom and is likely to spread to the rest of Europe, as can be seen in Belgium, Germany and Switzerland. Having ownership of your own data that can be benchmarked against other units in Europe offers individual surgeons considerable protection. It is in all our interests to make Spine Tango a continuing success and I would urge all spinal specialists to submit data to the registry

T. Pigott
Chair, on behalf of the Spine Tango committee
Profile

Spine Tango enables you to document the whole spectrum of spinal pathologies and the possible surgical and non-surgical treatment options. The generic approach of the Spine Tango documentation system is a must to reach the maximum number of participants using a common web based technology. This, in turn, reduces the potential for customizing the Tango in order to meet the individual expectations of specific users. There are, nevertheless, still a number of possibilities to parameterize the data collection processes according to the various hospital workflows in the user community. To give you the opportunity to document not only the surgical treatments, we have developed Spine Tango Conservative, which is increasingly being used by spinal units to document their hospitalized but nonsurgically treated cases. Also, the two specialist add-on questionnaires for adolescent scoliosis and degenerative deformities do allow a more detailed and in-depth documentation of complex deformity cases. Spine Tango is an international, non-commercial system under the auspices of EuroSpine, the Spine Society of Europe aiming at enabling national societies to organize and control their own part of the registry. For that a technology called “national module concept” has been implemented to enhance participation options and to provide the hardware structure for appropriate security measures for patient and user privacy protection. The constantly and further developed software of the MEMdoc portal does further improve these aspects. In conclusion, Spine Tango is a unique applied medical and scientific documentation and technology solution. It is to the benefit of patients, physicians and therapists whilst generating evidence based findings to improve spinal care (1, 2).


# Registries versus Randomized Controlled Trials (RCT)

<table>
<thead>
<tr>
<th>RCT</th>
<th>Registry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of evidence</strong></td>
<td>Efficacy</td>
</tr>
<tr>
<td><strong>Principal question</strong></td>
<td>Can it work?</td>
</tr>
<tr>
<td><strong>The first step of evidence generation</strong></td>
<td>Verification in daily clinical practice</td>
</tr>
<tr>
<td><strong>Internal validity (methodological quality)</strong></td>
<td>+++</td>
</tr>
<tr>
<td><strong>External validity (transferability/ generalizability)</strong></td>
<td>- - +</td>
</tr>
<tr>
<td><strong>Bias &amp; Confounding</strong></td>
<td>Low to very low</td>
</tr>
<tr>
<td><strong>Levels of evidence</strong></td>
<td>1a, 1b, 2a</td>
</tr>
<tr>
<td><strong>Hypothesis-based approach</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Duration of observation period</strong></td>
<td>Predefined</td>
</tr>
<tr>
<td><strong>Focus of research/measurement</strong></td>
<td>Sharp, narrow (see hypothesis)</td>
</tr>
<tr>
<td><strong>Quality assessment</strong></td>
<td>Not intended (strictly defined indications, process quality at least derivable, outcome quality depends on effectiveness, a given indication and process)</td>
</tr>
<tr>
<td><strong>Early warning system</strong></td>
<td>Not possible</td>
</tr>
<tr>
<td><strong>Long-term follow-up</strong></td>
<td>Feasible</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Only among participants</td>
</tr>
<tr>
<td><strong>Benchmarking</strong></td>
<td>Only benchmarking of group</td>
</tr>
<tr>
<td><strong>Type of quality assurance</strong></td>
<td>Internal, external vs. benchmark of participants</td>
</tr>
<tr>
<td><strong>Effort</strong></td>
<td>Very high for a few participants</td>
</tr>
<tr>
<td><strong>Cost per case</strong></td>
<td>High to very high</td>
</tr>
<tr>
<td><strong>Cost per study</strong></td>
<td>High to very high</td>
</tr>
<tr>
<td><strong>Availability of potential patients</strong></td>
<td>Low to medium</td>
</tr>
<tr>
<td><strong>Commitment of patients</strong></td>
<td>High</td>
</tr>
<tr>
<td><strong>Use of generated data</strong></td>
<td>Only in the framework of the scientific goal/hypothesis</td>
</tr>
<tr>
<td><strong>Comparator</strong></td>
<td>Given per definition</td>
</tr>
<tr>
<td><strong>Availability of results</strong></td>
<td>At the end of the study (except interim analysis)</td>
</tr>
</tbody>
</table>

*unclear terminology, Cochrane called it "efficiency", better always specify what you mean (evidence derived from controlled experiment versus evidence derived from routine clinical practice)

**Table 1: Comparison of RCT and registry characteristics**

The father of Evidence Based Medicine. Effectiveness and Efficiency.
Random Reflections on Health Services.
London: Nuffield Provincial Hospitals Trust, 1972
New Developments

**Improved online statistics:** the selected patient sample can soon also be connected to the followup and COMI forms of the respective surgical forms for analyzing treatments and outcomes with one and the same query. It is also planned to improve the output style for nicer looking tables and graphs generated by the Highcharts software.

**Complex search tool:** the current search tool allows searching patients by demographic characteristics, form type, form characteristics and certain form attributes. In the future, patients can also be searched based on outcomes of clinical parameters, i.e. all questions and answers on all forms can be used to specify a patient search. The hit list can either show the related patients or the related forms.

![Extended search mask](image)

*Figure 1: Newly extended search mask with possibilities to further specify the search with patient characteristics, surgical details or postoperative information*
New Developments

**Surgimap interface:** Thanks to the deformity working group of the German Spine Society DWG an interface to the Surgimap image analysis software was created. This interface will be also implemented for the Spine Tango registry and allows importing measurement data directly into the new Spine Tango adolescent scoliosis and adult deformity add-on forms.
Application

Quality control, health service, comparative effectiveness and outcomes research, postmarket surveillance of implants, national and international study network.

Internal quality control: assuming that you have a complete data collection, Spine Tango enables you to monitor all types of surgery during a specific period, observing the date and duration of operation, patient characteristics and outcomes (patient- and physician-based). The comprehensive annual report that users receive in their “Documents” section can be used for performance description and comparison with previous years.

External quality control: benchmarking, the comparison of own performance with that of the national or international results in the Tango data pool is a powerful management tool because it overcomes “paradigm blindness.” Paradigm blindness can be summed up as the mode of thinking “The way we do it is the best because this is the way we’ve always done it”. Benchmarking opens organizations to new methods, ideas and tools to improve their effectiveness. It helps overcome resistance to change by presenting successful methods of problem solving that are different to the ones currently employed. Enabling benchmarking possibilities is one of the fundamental goals of the Spine Tango venture. The benchmarking report compares the user’s accumulated data with the accumulated pool data.

Code of Conduct: the underlying principles for participation in the Spine Tango registry have been written up by the ST committee and were distributed in the second half of 2014. The Code of Conduct shall serve as a common agreement between all registry stakeholders for ensuring that the collected data itself is of an acceptable quality which does no compromise the overall goals of the project.

Health services research: as a subdiscipline of health systems research, this young science is an interdisciplinary field that describes and causally explains the provision of health services to the diseased and the healthy, contributes to the development of new concepts for delivery of health services and scientifically accompanies their implementation, and evaluates the effectiveness of structures and processes of healthcare delivery under routine day-to-day conditions. The focus of health services research is the “last mile” of the health care system, where the concrete and decisive delivery of care takes place in hospitals, practices and other institutions.

Outcomes research: this aspect is actually just taking a different view for the same basic activity, i.e. the systematic and prospective collection of key data regarding interventions and outcomes for and of spinal pathologies. While quality assurance is rather used for the purposes of improving ones’ own standards of care, outcomes research wants to generate new medical and scientific knowledge and make it available in the peer-reviewed literature.

Postmarket surveillance of implants: implants play a major role in modern spine surgery and just like in the domain of total joint arthroplasty their true performance can only be evaluated by systematically following the devices after implantation and documenting their outcomes in large clinical databases like the Tango. In Switzerland, all spinal implants become part of the governmentally mandated Swiss Implant Registry as of 2016.
National and international study network: the Tango is a technology backbone and currently networks about 40 active hospitals in Europe, North and South America, Australia and Asia. This provides great opportunities for national and international multicenter studies that piggyback on the ongoing routine data collection, add some hypothesis based questions and collect this extra information for the time of primary and follow-up data collection as specified in the joint study protocol. A mini study protocol template for composing the first draft of a study idea and discussing it with the Spine Tango committee or the study participants is now available for download on the Spine Tango webpage under “Forms”.

Research with Spine Tango

Scientific articles using Spine Tango data are increasingly published and cited in the peer reviewed literature. An output from ISI Web of Knowledge about the scientific publications and impact of Spine Tango related research over the years is shown

Results found: 32

<table>
<thead>
<tr>
<th>Sum of the Times Cited: 260</th>
<th>Citing Articles: 177</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of Times Cited without self-citations: 203</td>
<td>Citing Articles without self-citations: 154</td>
</tr>
<tr>
<td>Average Citations per Item: 8.12</td>
<td>h-index: 11</td>
</tr>
</tbody>
</table>

Reference Web of Science / Thomson Reuters
Data entry

There are 6 possible ways data can be transferred to the database (Figure 7):

1. Online data entry via the web-interface using stationary computers or wireless tablet devices (no software to be installed).
2. OMR (Optical Mark Reader) i.e. scanner-assisted entry of paper forms.
3. Using the webservice or webservice client interfaces data can be automatically imported from clinic information systems.
4. Paper based data capture with mailing to the IEFM or other partner institutions for OMR scanner-assisted entry of paper forms.
5. A handheld barcode scanner with USB (cable) or bluetooth (wireless) interface can be used to enter the exact implant information into the surgery form. Alternatively the online supplier catalogues or a section for manual entry of implant data is available.

An addition is the hybrid method of online data entry and OMR scanner-assisted entry of paper forms (not pictured). In the rectangles multiple methods of gathering patient and physician generated data are shown (by mail, inhouse, outpatient clinics, telephone and new electronic media).

The goal to generate a comprehensive database is achieved by collecting data of the patient layer and the clinic/physician layer. Having created a consistent data set the options of analyses are almost unlimited. Outcome evaluation can now be done in particular.
A complete case

Following Ernest Codman’s “end result system” the result of a surgical intervention should be recorded if the outcome can be considered as definitive (3). In most cases of spinal surgery, this can be done after a minimum of 3 months after surgery as demonstrated by Mannion et al (4). In accordance with figure 8. EuroSpine encourages one physician and patient based follow-up in the first year after surgery, ideally later than 3 months postop, and further, at least patient based follow-ups around year one and two after surgery. The registration of complications at any time during the postoperative period is self understood. Patient based outcome documentation with the COMI (Core Outcome Measure Index) questionnaires for neck and back pain has become an essential part of the Spine Tango documentation (5). Figure 9 on the next page illustrates the ideal case of a completely documented treatment (6).


![Figure 8: Patient based outcome documentation with the COMI (Core Outcome Measure Index) questionnaires, AF Mannion et al. (2009)(4)](image)
Pre- and postoperative documentation workflow of a case

Apart from the preoperative assessment of patients’ quality of life and the recording of the surgical intervention, the Spine Tango Code of Conduct recommends one physician- and patient-based follow-up around the 3 months postoperative time interval. In accordance with international standards in the medical literature, an additional and at least patient-based follow-up for the follow-up intervals 1 year and 2 years is highly recommendable. If a physician-based follow-up can also be achieved, a perfect outcome documentation is in place.
Statistics in Spine Tango

Various statistical analyses are performed in Spine Tango based research. The used methods include descriptive analyses for data exploration, parametric and non-parametric tests, univariate and multivariate linear and logistic regression analyses (7, 8, 9, 10) and inverse probability of treatment weighting using the propensity score (11). Comparative effectiveness research studies across different spine registries were also published (12, 13). A first matching study was just performed and received an outstanding paper award from “The Spine Journal” of NASS in 2015 (14). Additionally to clinical studies, a multitude of reliability and validation studies of the COMI form in different languages were performed and published in the last decade. Furthermore, the preliminary experience with the assessment of predictors of surgical outcome using Spine Tango data has led to a large project aiming to develop clinical prediction models of patient outcomes in a leading Spine Tango hospital in Switzerland. Finally, the Spine Tango Research Group continuous its work on the epidemiological description of patient, treatment and outcome characteristics of different diagnostic groups (the so-called Benchmarking Project). A new challenge is the minimization of Spine Tango documentation for implant registry purposes. The mandatory Swiss minimal data set for the SIRIS spine registry will be purely based on index and reoperation/revision surgeries. With just one form, i.e. the Spine Tango surgery form, a quality assurance system for hospitals and implants will have to be developed. For putting such a system into place we intend to use the concept of revisions per 100 observed component years (r100ocy) from international joint implant registries and convert it to revisions per 100 observed surgery years (r100osy).


The Spine Tango database’s number of COMI forms has made a visible leap in the year 2014. Thanks to a joint effort of the Spine Tango documentation team at Schulthess hospital in Zurich and the IT group of IEFM at the University of Bern, over 35’000 COMI back and 7’000 COMI neck forms could be imported from the Schulthess clinic information system into the respective surgeons’ Spine Tango accounts.

Figure 10: Growth curves of implemented forms (primary and staged surgery and follow-up) as well as COMI low back and neck over the years.
Part I: Descriptive analysis form version 2011
Surgery Form

Sample description

Since January 2012 the newly developed Spine Tango form version 2011 was exclusively used for data collection. Consequently, the information gained during the years 2012 - 2014 is based on these new forms while the previous annual reports covered the complete data pool based on the SSE form versions 2005 and 2006. For this annual report 2014 we will exclusively show information retrieval with the form version 2011. In total the form version sample 2005 and 2006 counts 48`140 surgeries. Until the end of 2014 33'745 new surgeries could be registered with the form version 2011.

Figure 11: Distribution of age by gender (at surgery), all cases based on surgery form version 2011 (N=33'745)
Admission Subform

Length of stay (LOS)

The hospitalization times (length of stay [LOS]) were compared between the 4 biggest Spine Tango modules (Switzerland, Great Britain, Germany, Belgium). Differences between countries, respectively health care systems become visible in that the NHS in the UK seems to promote short-term hospitalisations up to two days, followed by Belgium where about half of the patients stay no longer than five days. Overall, the majority of patients is hospitalized between zero to eight days. No adjustment of LOS was made for case mix.

![Figure 12: Length of stay for the surgery form version 2011 (N 32'657)](image-url)
Admission Subform

Body Mass Index (BMI)

A comparison of BMI distribution also reveals slight differences. Switzerland has the highest percentage of patients with normal BMI, whereas Germany has the highest percentage of overweight and obese patients. Patients at the extreme ends of the spectrum (very low or very high BMI) are rare in all four countries.

Figure 13: Distribution of body mass index (BMI), surgery form version 2011 (N= 32'721)
Admission Subform

Smoking Status

Belgium seems to have the greatest percentage of non-smoking patients, whereas the percentage of smoking patients is rather equal in Switzerland, Germany and the UK.

Figure 14: Distribution of current smoking status, surgery form version 2011 (N=32'721)
Admission Subform

Risk factors - flags

The flags are a parameter for risk adjustment. It is a classification/assessment for the treatment of low back pain (LBP) patients considering psychosocial risk factors. The psychosocial flag system can help e.g. occupational health practitioners to create suitable rehabilitation plans for employees. A brief legend of the meanings of the different colors is given in table 2.

<table>
<thead>
<tr>
<th>Flag</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red:</td>
<td>Biomedical Factors; serious spinal pathology</td>
</tr>
<tr>
<td>Yellow:</td>
<td>Psychosocial or behavioral factors</td>
</tr>
<tr>
<td>Orange:</td>
<td>Abnormal psychological processes indicating psychiatric disorders</td>
</tr>
<tr>
<td>Blue:</td>
<td>Socioeconomic/ work factors</td>
</tr>
<tr>
<td>Black:</td>
<td>Occupational and societal factors</td>
</tr>
</tbody>
</table>

Table 2: Description of flag types

Risk factors - flags

Figure 15: Distribution of risk factors - flags, all patients with surgery form version 2011 (N= 33'219)
Admission Subform

Distribution of main pathology

As compared to last year’s report the degenerative diseases have increased from 76.5% to almost 80%. The second most frequent “pathology”, though not a true one, remains the failed and repeat surgery staying stable around 6%. This combined question offers answers about true treatment failures like non-union or neurocompression but also about reasons for elective repeat surgeries like hardware removal.

Figure 16: Distribution of main pathology for the surgery form version 2011 (N= 33'745)
Figure 17 shows the distribution of the answer categories of the question about degenerative diseases. Disc herniation is the most frequent type of degeneration, but if the different types of spinal stenosis are added up, they are even more frequent.
Admission Subform

Specification of spondylolisthesis

Four out of five patients with spondylolisthesis suffer from a degenerative type. The isthmic type makes up about 15%, the congenital type about 3%.

*Figure 18: Distribution of type of spondylolisthesis for the surgery form version 2011 (N= 3’844)*

Age distribution by gender

*Figure 19: Distribution of age by gender (at surgery), patients with type I spondylolisthesis (congenital, dysplastic)*
The age and gender distribution of the three most frequent types of spondylolisthesis is rather mixed for the congenital/dysplastic patients, whereas the isthmic type shows an almost perfect Gaussian curve, and the degenerativ type has a clear shift towards older patients with a still rather equal gender distribution.
Admission Subform

Aetiology of deformity

With the ageing society many more degenerative compared with idiopathic, congenital or neuromuscular deformities are surgically treated. For these types of interventions, two specialist add-on forms are available in Spine Tango. The age distributions make it obvious why there is an „adolescent scoliosis“ and an „adult degenerative deformity“ form.

Figure 22: Distribution of predominant aetiology of deformity for the surgery forms version 2011 (N= 2'006)

Figure 23: Distribution of age by gender, patients with idiopathic scoliosis
Admission Subform

Age distribution by gender

**Figure 24:** Distribution of age by gender, patients with congenital deformity

**Figure 25:** Distribution of age by gender, patients with degenerative deformity
Admission Subform

Type of repeated / failed surgery

Figure 26: Type of failed/ repeated surgery for the surgery form version 2011 (N= 2'033)

About 6% of cases (N=2'033) recorded in 2012 - 2014 were repeat surgeries. Neurocompression is the most frequent reason for a reintervention (23.9%), followed by adjacent segment pathology (23.2%) and instability (20.6%). Hardware removal was performed in 20.9% of cases. This surgical measure does not necessarily imply a failed index surgery, which explains the new variable name “repeat surgery”. Failure to reach the initial therapeutic goals was given as a reason for repeat surgery in 19% of cases.
Figure 27: Distribution of therapeutic goals/ goals of surgery for the surgery form version 2011 (N= 33’745)

The therapeutic goals can be more precisely defined in the form version 2011. Pain relief was split into axial and peripheral pain relief to consider back/ neck and leg/ arm pain. The neurological improvement can now be specified as sensory, motor and bladder/sex function improvement. Further new answer options are spinal stabilization, stop deformity progression and prophylactic decompression.
Surgical Measures Subform

Specification of surgical measures for the degenerative diseases

A comparison of the surgical measures for the degenerative cervical and lumbar spinal diseases shows an inversely mirrored proportion of solely decompressive interventions which dominate in the lumbar spine and decompressions with rigid stabilization and intention to fuse in the cervical spine. All other surgical measures and their combinations are rather rare.

Figure 28: Specification of fusion promoting measures, surgery form version 2011 (N= 13’237)
Surgical Measures Subform

Specification of fusion promoting measures and materials

Contrasting the cervical and lumbar fusion promoting measures it becomes obvious how the A-IF (anterior interbody fusion) dominates the cervical surgery. There must be a terminology gap in the ST surgery form since the second most frequent cervical fusion promoting measure is specified as “other”. On the other hand, four measures dominate the lumbar surgery: TLIF, PLIF, posterolateral fusion and the A-IF. “Other” fusion promoting measures are basically not documented in the lumbar interventions.

Locally procured autologous bone is the most frequently used fusion material in the cervical and the lumbar interventions. Bone substitute (cervical) and harvested autologous bone (lumbar) come in second place, and harvested autologous bone (cervical) and bone substitute (lumbar) in third place.
The surgical complications are divided into intraoperative complications and complications occurring during hospitalization before discharge. For intraoperative complications which are shown in figure 31 a dura lesion remained the most frequent complication with 4.7%, which is almost unchanged compared with the last report. No intraoperative surgical complications occurred in 94% of cases, in 0.4% they were not documented.
Hospital Stay Subform

Surgical complications before discharge

Postoperative complications which occurred during hospitalization are shown in figure 32. Their distribution is very stable over time. The most frequent complications were motor dysfunction with 0.9%, sensory dysfunction with 0.7% and radiculopathy with 0.5%. Even though a dura lesion was the most frequent complication during surgery, a CSF leak/pseudomeningocele occurred in only 0.5% of cases. In 0.6% of cases the complications before discharge were not documented, in 95.1% of cases no postoperative complications occurred.

![Figure 32: Distribution of surgical complications before discharge, excluded was the answer “none”, surgery form version 2011 (N= 33'743)](image-url)
Hospital Stay Subform

Status of complications

The status of complications at discharge refers to all cases with an intra and/or postoperative complication at hospitalization. For the sample based on the form version 2011 2'990 cases with complications were documented. In 63.5% of those cases the complications were resolved at discharge, in 6.9% they were persisting.

Figure 33: Status of complications at discharge for patients with an intraoperative complication and/or a complication before discharge, for surgery form version 2011 (N= 2'990)
SPINE TANGO Statistics

Followup Form
Follow-up Form

Distribution of follow-up interval

In the following section we refer to the Spine Tango follow-up form 2011. The majority of documented follow-ups in the routine clinical setting are captured at 6 weeks and 3 months after surgery. The literature suggests that at least the mid-term outcomes at three months can basically be considered as the final outcomes (Mannion et al. (4); Strömqvist et al. (15)). 6-month, 1-year and longer follow-ups are strongly recommended, but remain a major challenge of any routine care registry.

![Figure 34: Distribution of followup interval for the followup form version 2011 (24’973 forms for 15’721 patients)](www.eurospine.org/spine-tango.htm)

Form version 2011: 24’973 FUs /15’721 patients. The current mean FU time improved from 169.7 days (2013 report) to 210.9 days, if last available FU is considered.


Follow-up Form

Overall outcome / surgical goals

Figure 35: Physician based overall outcome (surgeon) for the surgery form version 2011 (N=24'973)

Converting the surgeon based outcome rating into a binary format, about 4 out of 5 cases have a desired outcome, and 1 out of 5 cases has an undesired outcome.

Figure 36: Cluster analysis of the most frequent combinations of surgical goals

The three most frequent combinations of therapeutic goals are peripheral pain relief only, a combination of peripheral and axial pain relief, and functional improvement in addition to peripheral and axial pain relief.
Follow-up Form

Surgical goals – pain relief and functional improvement

Figure 37: Achievement of the surgical goals pain relief and functional improvement for the follow-up form version 2011.

According to the aforementioned cluster analysis the figure shows pain relief and functional improvement and the extent to which these goals are achieved. Peripheral pain relief is the best achieved surgical goal and in about half of all cases the surgeons indicate a complete goal achievement and in just under 40% an at least partial achievement. Axial pain relief and functional improvement are slightly more difficult to achieve. In a little under 90% these goals are completely or partially achieved. In about 10% of patients pain relief and functional improvement are not achieved.
Follow-up Form

Surgical goals – neurological improvement / additional goals

Figure 38: Achievement of the surgical goals motor improvement (N=2681), sensory improvement (N=2473) and bladder/sex function improvement (N=264) for the followup forms version 2011

Figure 39: Achievement of additional surgical goals (spinal stabilization (N=1’924), stop deformity progression (N=836) and prophylactic decompression (N=346) for the followup form version 2011
PART II: The Spine Tango Benchmarking Project


Introduction

The objective of the Spine Tango benchmarking project is to create reference values for patient characteristics, treatment practices and their outcomes. Cochrane noted that the results of such registry analyses demonstrate high external validity, i.e. generalizability, because they more adequately reflect the true heterogenic nature of health service delivery and its outcomes [16]. Three simple questions summarise Cochrane’s scheme: can it work (efficacy)? Does it work (effectiveness)? Is it worth it (cost effectiveness)? Even if a surgery is successful in a study, it may not succeed similarly in normal everyday care [17]. Consequently, the Spine Tango benchmarking project aims to analyse the most frequently encountered treatments for the most common degenerative diseases of the spine, in order to find out if and to what extent spinal surgeries “do” work in day-to-day clinical settings. However, the question “Is it save?” is also of outmost importance, even for the most efficacious or effective treatments. Patients and payers are highly interested in the safety of a therapy per se, but also in the hands of an individual healthcare provider. Some therapies may be generally save or unsave, others may show a larger variation of complication rates between centers. Disc herniation and spinal stenosis, making up about two thirds of all degenerative diseases recorded with Spine Tango, and degenerative spondylolisthesis in addition are the pathologies that were assessed regarding perioperative (intra- and postoperative until discharge) surgical complications using funnel plots, thereby stratifying by location in the spine and type of surgery. No further case mix adjustments like for the extent of lesion or for previous surgeries were made. This second part of the 2014 annual report highlights the complication rates of these pathologies and the most frequently seen treatments for them, which are decompression alone and decompression with instrumented fusion.

Materials and Methods

The last three versions of the surgery form were used in the analysis: ‘Surgery 2005’, ‘Surgery 2006’ and ‘Surgery 2011’. Since the 2005 and 2006 forms only asked for surgical complications without discriminating between intraoperative and postoperative ones, the intra- and postoperative complications recorded on the 2011 form version were pooled. Based on the consensus of the Spine Tango Registry Committee, detailed inclusion and exclusion criteria were defined for cervical and lumbar disc herniation, degenerative spondylolisthesis, and spinal stenosis (see http://www.eurospine.org/forms.htm). These criteria were applied to form distinct degenerative diagnosis subgroups. The only additional exclusion criterion used was a number of treated cases per hospital below 5. Patient populations and the number of treating centers are listed for the individual diagnosis subgroups below. Perioperative surgical complication rates per treating hospital were displayed using funnel plots accounting for the caseload of the hospital. Average surgical complication rate with 95% confidence intervals (funnel) are shown.
Results

Cervical disc herniation treated with decompression and instrumented fusion
2’335 patients from 32 hospitals were included in the analysis (Figure 40). Average perioperative complication rate was 2.4%. The proportion of incidental dura lesions was 0.5%. The therapy appears as generally save regarding perioperative complications with basically no outlier hospitals. Higher variation between low caseload-hospitals can be anticipated due to heterogeneity in case mix.

![Figure 40: Cervical disc herniation treated with decompression and instrumented fusion.](image)

Cervical spinal stenosis treated with decompression and instrumented fusion
333 patients from 16 hospitals were included in the analysis (Figure 41). Average perioperative complication rate was 10.5%. It becomes obvious that the average complication rate of this procedure and underlying pathology is much higher compared with, cervical disc herniation. The proportion of incidental dura lesions was 1.2%, thus, not explaining the high overall complication rate. However, the complication rates are much more scattered among the participating hospitals which hints at a greater influence of the individual surgeon on the safety of this type of surgery.

![Figure 41: Cervical spinal stenosis treated with decompression and instrumented fusion.](image)
Cervical spinal stenosis treated with decompression alone
585 patients from 12 hospitals were included in the analysis (Figure 42). Average perioperative complication rate was 3.9%, which is lower than that after decompression accompanied with instrumented fusion for the same pathology. The proportion of incidental dura lesions was 0.3%.

![Figure 42: Cervical spinal stenosis treated with decompression alone.](image)

Lumbar disc herniation treated with decompression alone
13,917 patients from 58 hospitals were included in the analysis of this most frequent pathology and surgery on the spine (Figure 43). Average perioperative complication rate was 4.5% and almost all hospitals were inside the average with 95% confidence intervals with three close-to-average outliers. The procedure seems generally sufficiently save with no relevant differences between the various participating centers and surgeons.

![Figure 43: Lumbar disc herniation treated with decompression alone.](image)
Lumbar degenerative spondylolisthesis treated with decompression alone
1'481 patients from 31 hospitals were included in the analysis (Figure 44). With an average 12.6% of perioperative surgical complications this pathology and surgery represents the most prone to surgical complications. Their clinical relevance may be less dramatic and need to be analyzed in detail for an accurate interpretation. A particularly high rate of incidental dura lesions of 9.0% is documented in this subgroup. In 63.9% the dura lesion was associated with an intervention during or a reintervention after surgery. However, variation of complication rates was considerable even between centers with higher case load and a ≥20% perioperative complication rate seems to be also possible.

Figure 44: Lumbar degenerative spondylolisthesis treated with decompression alone.

Lumbar degenerative spondylolisthesis treated with decompression and instrumented fusion
2'811 patients from 47 hospitals were included in the analysis (Figure 45). With an average 9.5% of perioperative surgical complications this procedure displayed slightly lower complication rates than the sole decompressive treatment. The incidental dura lesion rate was 4.9%, while 89.1% of them were associated with an intervention during or a reintervention after surgery.

Figure 45: Lumbar degenerative spondylolisthesis treated with decompression and instrumented fusion.
**Lumbar spinal stenosis treated with decompression alone versus treatment with decompression and instrumented fusion**

10'631 patients from 51 hospitals (decompression alone) and 2'298 patients from 38 hospitals (decompression and instrumented fusion) were included in the analysis (Figures 46, 47). Complication rates were well comparable with 9.6% and 9.8%, respectively. However, incidental dura lesion rate was higher after decompression alone (7.3%) than after decompression and instrumented fusion (5.0%). Also, more hospital outliers were observed after decompression alone representing both higher and lower than average rates.

![Figure 46: Lumbar spinal stenosis treated with decompression alone.](image1)

![Figure 47: Lumbar spinal stenosis treated with decompression and instrumented fusion.](image2)


Participants / Module Analysis

Figure 48 displays the cumulative growth curves of the various national modules. The different starting dates of the modules need to be considered (Swiss/International 2005, Austria 2005; Germany 2006; North America 2007; Brazil/South America 2008; Italy 2008; Mexico 2008; Great Britain 2010; Australia 2010). During 2012 the North American, Brazilian and Mexican modules have been combined to the Pan American Module. The Swiss/International module was divided into one Swiss and one International module. The Polish module was launched in 2013, but due to migration of active users from the international module there is data from 2011 onwards in the Polish module database. A similar situation exists for the Belgian module which was launched in 2014. The Australian and British modules are both not available via www.eurospine.org because of national data privacy regulations, but the contact persons for these modules are displayed on the Spine Tango web page.

The hospital classification of all active 39 Spine Tango clinics actively documenting in 2014 can be seen in figure 49. The highest proportion is made up by university or teaching hospitals with 42%. Figure 50 shows an overview of the Spine Tango participating hospitals and their country of origin until the end of 2014. We divided their total case load into primary forms, follow-up forms and COMI forms.
Spine Tango 2011 forms per participating country (active hospitals)
by the end of 2014

Figure 50: Overview of the Spine Tango participating hospitals according to their country of origin with case load divided into primary forms 2011, follow-up forms and COMI forms until the end of 2014.
## Available Questionnaires

**Table 3: Available questionnaires in the SSE Spine Tango registry (01.08.2015)**

<table>
<thead>
<tr>
<th><strong>Forms used in Spine Tango Registry</strong> - 01.08.2015</th>
<th><strong>online available</strong></th>
<th><strong>OMR paper forms available</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Registry Forms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spine Tango Surgery 2011</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Staged 2011</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Follow-up 2011</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Conservative treatment 2011</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Adult deformity add-on</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Adolescent scoliosis add-on</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td><strong>Patient Forms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spine Tango Core Outcome Measures Index: COMI Neck</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Core Outcome Measures Index: COMI Back</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Core Outcome Measures Index: COMI Neck Conservative</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Core Outcome Measures Index: COMI Back Conservative</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Oswestry Disability Index ODI 2.1</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Neck Disability Index NDI</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango Scoliosis Research Society: SRS 30</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango EuroQol™: EQ-5D™</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango RMQ - Low Back and Disability Questionnaire</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Spine Tango SAQ Spinal Appearance Questionnaire</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td><strong>Examination Forms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spine Tango Examination: ASIA Score (Beta)</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
</tr>
</tbody>
</table>

OMR = Optical Mark Reader
Publications 2014

Papers in peer reviewed Journals

Al-Mahfoudh R, Qattan E, Ellenbogen JR, Wilby M, Barrett C, Pigott T.

Bellut D, Mutter UM, Sutter M, Eggspuehler A, Mannion AF, Porchet F.

Mannion AF, Fekete TF, Porchet F, Haschtmann D, Jeszenszky D, Kleinstück FS.

Kleinstueck FS, Fekete TF, Jeszenszky D, Haschtmann D, Mannion AF.

Murray NJ, Demetriades AK, Rolton D, Nnadi C.
Authors

Christoph Röder, MD MPH
Spine Tango Committee, EuroSpine
Associate Professor, Director
Institute for Evaluative Research in Medicine
University of Berne, Switzerland

Emin Aghayev, MD MSc
Spine Tango Committee, EuroSpine
Senior lecturer, Group Head Evaluative Clinical Research
Institute for Evaluative Research in Medicine
University of Berne, Switzerland

Everard Munting, MD
Former Chair Spine Tango Committee, EuroSpine
Head of Orthopaedics, Clinique Saint Pierre
Ottignies, Belgium

Tim Pigott, MD
Chair Spine Tango Committee, EuroSpine
Head of Neurosurgery, Walton Centre for Neurology and Neurosurgery
Liverpool, United Kingdom

Rolf Sobottke, MD
Spine Tango Committee, EuroSpine
Head of Orthopaedics, Würselen Hospital
Aachen, Germany

Anne Mannion, PhD
Spine Tango Committee, EuroSpine
Head of Spine Research, Schulthess Clinic
Zurich, Switzerland

Gosia Perler
Statistician
Institute for Evaluative Research in Medicine
University of Berne, Switzerland