



Original Investigation

Spine Tango in Turkish: Development of a Local Registry System

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ABSTRACT

AIM: Successfully established registry systems, rather than personal efforts to collect data, are required to record, analyze, compare and secure patient related data. Unfortunately, our country does not have such patient registry systems for spinal pathologies and surgeries at this time. In order to fill this gap in patient management in Turkey, the authors adopted already established Spine Tango registry system in a unique way answering the requirements of our health system. This article aims to present the adaptation process of Spine Tango forms for use in Turkish and describe the first implementation with 50 patients treated for spinal pathologies in a tertiary referral center.

MATERIAL and METHODS: In 2011, an effort was initiated by the first author to translate the original Spine Tango forms into Turkish. Funding for this project was provided by authors themselves. With the assistance of a Spine Tango team, the translation process was completed. The Turkish forms were then used in an academic institution with a high spinal workload. A local solution was developed by the authors using commercially available software and mobile instruments. This system was tested with 50 spine patients from June 2012 to January 2013.

RESULTS: The analysis of the data gathered using the new Turkey Spine Tango registry system was successful.

CONCLUSION: In an environment of exponentially increasing medical data, successfully established registry systems have the potential to facilitate patient management. The authors recommend the use of Turkish Spine Tango forms for clinics performing spinal interventions.

KEYWORDS: Electronic medical records, Patient registry, Spine tango

■ INTRODUCTION

As the use of technology increases, the amount of data that we are exposed increases exponentially every day. Access to healthcare has also increased throughout the world, especially in developing countries. Together, these changes result in an enormous accumulation of medical data. Careful handling and evaluation of this data with user-friendly and subject-focused registry systems is necessary to provide satisfactory patient management.

Spine Tango is an established patient registry system developed under supervision of the Spine Society of Europe. It is constructed to collect data from world-wide contributors and aims at improving patient management by analyzing the collected data of individual users and the complete data pool.

This paper describes the successful adaptation of a patient registry system specifically designed for spine pathologies, Spine Tango, into Turkish. The authors share their experiences with Spine Tango and provide some suggestions regarding the registry system.



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■ MATERIAL and METHODS

Preparation of Translations and Data Recording

The study was designed to record data from 50 consecutive patients with complex spinal pathologies using the Spine Tango data structure. The primary aim was to determine the usability of the Turkish versions of the Spine Tango forms. After preparation of the recording system described below, data collection began in June 2012 and concluded in January 2013 when data from 50 patients had been collected. Patients requiring staged surgeries were excluded from this study.

English versions of the surgery and follow-up forms were translated into Turkish with the assistance of the Spine Tango team. We did not follow a validated, scientific translation methodology for the forms, mainly because of their “physician-based” nature. After translating the original forms into Turkish, the Spine Tango team constructed Turkish forms in a portable document format (PDF) with a layout similar to that of the original English forms (see PDF file, Supplemental Digital Content 1, which shows a sample of Spine Tango form in Turkish in the online version of the paper). The forms were then published on the Spine Tango web page (web link: <http://www.eurospine.org/p31000375.html>). These forms served as templates for data recording.

The Spine Tango developers have constructed a web-based system in which you can record patient data through a web interface to Spine Tango servers. These servers handle all aspects of data management and evaluation. However, to use this functionality, you must transfer your data either to a remote server located in another country or to a server located elsewhere in the users own country. Although the Spine Tango system provides strict security requirements based on the current internet technology, our institution felt uncomfortable in terms of medico-legal concerns regarding the collection and sharing of medical data in our country, we were not able to use powerful online features of the system. These limitations lead us to develop a local system for easy data handling based on the available Spine Tango forms.

To develop such a system, we first structured a user-friendly data collection environment to facilitate data capture and collection. To achieve this goal, a page layout was designed using MS Word (Microsoft Office Professional Plus 2010, Microsoft Cooperation, Washington, USA), and then the files were imported to Adobe Acrobat Pro software (version 11, Adobe, California, USA). The built-in “form preparation” function of Adobe Acrobat was used to produce forms with drop-down menus, radio buttons and checkmarks. Additionally to prevent incorrect data entry we applied data validation rules to the forms. The question format and data structure of the forms we developed were similar to the original paper forms; however, due to some limitations of the software, the page layouts were different (see PDF file, Supplemental Digital Content 2, which shows a sample PDF form used in this study in the online version of the paper).

The translated electronic forms were then transferred to a handheld tablet (iPad 2, Apple, California, USA) to provide mobility to the recorder. The forms were completed at the

patient's bedside or in the operating theater immediately after the surgical intervention using a commercially available application called “PDF Expert” (Igor Zhadanov, Version 4.3, retrieved from <https://itunes.apple.com/us/app/pdf-expert-fill-forms-annotate/id393316844?mt=8>).

For each patient, the surgeon recorded the interventions and other data required by Spine Tango. The measurement of time required to fill forms was performed in two steps. First the time passed during form filling at initial admission to the clinic was recorded. Then the time passed for recording surgical intervention details was recorded and the total time required filling whole forms was reported. Measurements were performed by an observer blinded to the process.

The data for each patient were collected as PDF files and recorded with a patient-specific identifier using the “save as” function of the “PDF Expert” software. This approach was also used for the follow-up forms at the initial follow-up visit typically performed 3 months after surgery.

The described system can be used by as many surgeons as required. We performed data collection for two surgeons from our clinic. The differentiation of record from each surgeon was performed simply adding an identifier to the name of the recorded final file in the PDF software.

After collecting data for 50 patients, the preliminary work of patient recording was complete. One hundred PDF files were collected; half for surgical data and the other half for follow-up data. The forms were then transferred to a desktop computer and using a built-in functionality of the Adobe Acrobat software, the data were exported to IBM SPSS Statistics for Windows (version 21.0, IBM, Armonk, NY) in spreadsheet format, and statistical analyzes were performed.

The follow-up forms suggested by Spine Tango primarily rely on physician judgment to determine the success rate of the surgical intervention, which is rated as poor, fair, good or excellent. Additionally, users can record the “therapeutic goals” of surgery preoperatively and then select “achieved”, “partially achieved” or “not achieved” in the follow-up form. The absence of an objective assessment scale for outcome is a major drawback of the current Spine Tango system. Although the online infrastructure permits additional questionnaires that include the COMI or Oswestry scale to be added to achieve a more objective assessment of outcomes, this approach requires the completion of additional forms pre- and postoperatively. Although, only surgery and follow-up forms of the Spine Tango system used in this study do not provide such functions, with the described development processes such quantitative forms can also be added to the current forms with ease. For now, we just wanted to see if such an effort is feasible and will be successful. Our goal is to expand the usage of this system.

In an attempt to quantify aforementioned subjective approach, we developed a quantitative formula to measure the success of the surgical results based on the number of achieved and partially achieved therapeutic goals. First, we recorded our therapeutic goals for each patient in the surgical form, and then, during the follow-up period, we recorded whether

these goals had been “achieved”, “partially achieved” or “not achieved” based on the radiological and clinical findings. Then, we developed the following simple formula to determine the overall success rate:

$$\left(\frac{\text{No of Achieved Goals}}{\text{No of Preoperative Goals}} \times 100 \right) + \left(\frac{\text{No of Partially Achieved Goals}}{2 \times \text{No of Preoperative Goals}} \times 100 \right)$$

Statistical Analyses

Descriptive statistics included the mean, standard deviation and median. The parametric data were analyzed using ANOVA and t-tests, and the Kruskal-Wallis and chi-square tests were applied to the non-parametric data. A p value of less than 0.05 was considered statistically significant.

RESULTS

The main objective of this work was to demonstrate the technical background of the data recording system development and the adaptation of the Turkish forms. For this reason, we do not report the statistical analyzes of patients in this paper. For those who are interested in the results obtained for these 50 patients, a supplementary file accompanies this paper (Tables I-V). Other data relevant to the purpose of this paper are summarized below.

The data handling infrastructure described above cost less than \$1,500 US. The tablet, desktop computer, remote back-up disc and software were the primary expenditures. No other personnel worked on this project, and all of the systems were developed by the authors of this paper.

The mean length of time to complete the forms was 14.7 ± 3.61 minutes (median 14.5, range 9–23 minutes). The time required to complete the form for each “main pathology” is shown in Figure 1. Recurrent surgery patients required more time than other patients; however, the difference was not statistically significant ($p=0.283$)

All of the surgeries were performed by one of two surgeons; Surgeon 1 performed 26 surgeries (52%), and Surgeon 2 performed 24 (48%). No significant differences in gender distribution ($p=0.98$), patients’ age distribution ($p=0.44$), surgical time (4 hours as the cutoff point, $p=0.698$), blood loss (1,000 ml as the cutoff point, $p=0.934$), need for blood transfusion ($p=0.674$), BMI distribution (27.34 as the cutoff point, $p=27.34$) or the use of an O-arm system ($p=0.674$) were detected between the surgeries performed by the two surgeons.

The mean follow-up time of the patient group was 3.9 ± 1.9 months (range 0.69–7.78 months).

The results of the proposed “success rate” calculation was as follows: in the preoperative period, 193 therapeutic goals were set by the surgeons for the 50 patients. Of these goals, 133 were achieved (68.91%), 46 were partially achieved (23.83%) and 14 (7.24%) were not achieved. The mean overall success rate based on the aforementioned formula was calculated as $80.20\% \pm 19.05$ for this patient cohort. The bar graph in Figure 2 shows the achieved and not achieved therapeutic goals. The success rates of the two surgeons were not significantly

different ($p=0.089$). Additionally, there was no difference in terms of success between patient groups classified according to the type of main pathology ($p=0.487$), surgery time ($p=0.108$), O-Arm usage (0.684), body mass index ($p=0.631$) preoperative morbidity status ($p=0.88$), or gender ($p=708$). The mean overall success rate calculated for the patients that encountered complications was $73.92\% \pm 23.32$.

DISCUSSION

Medical knowledge stems from various sources including experiments with humans and animals as well as the personal

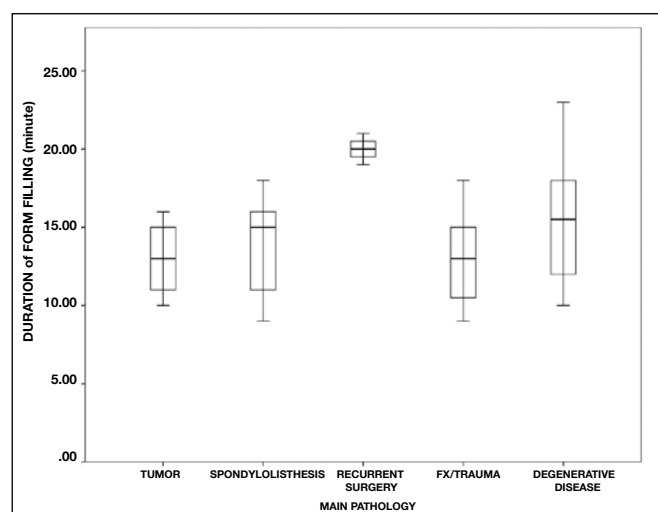


Figure 1: Box plot demonstrating time required for filling each form versus each “main pathology”.

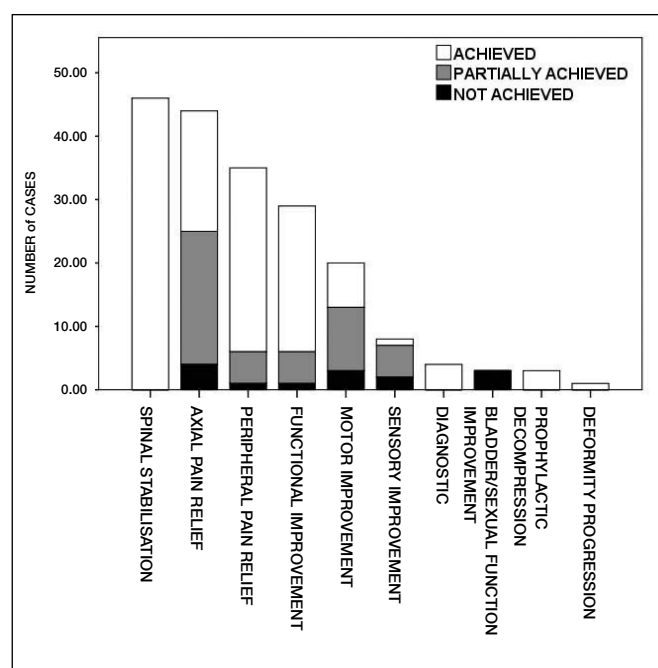


Figure 2: Bar graph demonstrating number of preoperative, achieved, partially achieved and not achieved treatment goals.

experiences of physicians. However, information based on animal studies has severe limitations because its adaptability to human subjects is almost impossible. In contrast, information gathered from humans is invaluable and provides information that cannot be collected from animals. Today, especially in developed countries, some type of medical data related to diseases is collected from the majority of the population. Tremendous volumes of data are generated every day, requiring proper data management procedures (2).

Today, most developing countries use medical data from developed countries to plan their own health systems. This largely arises from the absence of sufficient infrastructure for data collection and management. Unfortunately, this situation produces a gap between knowledge and practice since developing countries do not have medical data derived from

their own national population. This problem also diminishes their contribution to international science and increases their dependency on more developed nations.

The process of data management, particularly in a field such as medicine, is demanding. It requires dedicated personnel and significant funding to collect, store and interpret data. Furthermore, concerns about the security of personal data increase the burden. In our opinion, this issue should be handled as a health policy with governmental involvement.

There are various examples of successfully established registry systems throughout the world, especially in developed countries, that have helped improve established treatment protocols (3). In 2000, under the supervision of the Spine Society of Europe, a registry including all major spine pathologies and interventions was developed and is referred to as "Spine

Table I: Data Derived from "Admission/Pathology" Part of the Spine Tango Surgery Form

		n	% of cases
Age (years)			
Mean	51.68		
Std. Dev.	14.59		
Median	52		
Range	14-78		
Duration of hospitalization (day)			
Mean	5.24		
Std. Dev.	3.12		
Median	4		
Range	1-14		
Time between admission and surgical intervention (day)			
Mean	1.48		
Std. Dev.	1.52		
Median	1		
Range	1-7		
	n	% of cases	
Gender			
Female	35	70	
Male	15	30	
Level of Main Pathology			
Lumbar	25	50	
Thoracic	9	18	
Lumbosacral	6	12	
Mid-Lower Cervical	5	10	
Thoracolumbar	5	10	
Main Pathology			
Degenerative Disease	26	52	
Fracture/Trauma (all C3/L5S1 fx)	12	24	
Recurrent Surgery	3	6	
Spondylolisthesis	5	10	
Tumor (All secondary malignancy)	4	8	
Type of Degeneration			
Degenerative spondylolisthesis	21	19.3	
Degenerative disc disease	20	18.3	
Foraminal stenosis		20	18.3
Central stenosis		18	16.5
Disc herniation		15	13.8
Facet joint arthrosis		9	8.3
Lateral stenosis		5	4.6
Myelopathy		1	0.9
Type of Spondylolisthesis			
Type 1	1	2	
Type 2	4	8	
Type 3	22	44	
Type 4	1	2	
Type 5	0	0	
Type 6	3	6	
Grade of Spondylolisthesis			
Grade 1	20	40	
Grade 2	11	22	
Number of Previous Spine Surgeries		12	24
Previous surgeries at same level		7	14
Previous surgeries at same hospital		5	10
BMI			
<20	3	6	
21-25	10	20	
26-30	23	46	
31-35	12	24	
>36	2	4	
BMI			
Mean		27.78	
Std. Dev		4.32	
Range		17.72-39.06	
Current smoker		13	26

Tango.” The technological infrastructure of the system was developed to bypass or at least diminish the dependence on paper-based records and to reduce the required human and financial resources. According to a report published in 2011, the international Spine Tango registry included almost 50,000 cases, and it continues to grow (4). The main reason why we choose Spine Tango to adapt is its proven nature in terms of ability in collecting almost all aspects of spine related issues. However, as in any other patient registry infrastructure, it has some problems.

Table II: Data Derived from “Surgery” Part of the Spine Tango Surgery Form

	n	% of cases
Treatment Aims		
Spinal stabilization	46	92
Axial pain relief	44	88
Peripheral pain relief	35	70
Functional improvement	29	29
Motor improvement	20	40
Sensory improvement	8	16
Diagnostic	4	8
Prophylactic decompression	3	6
Bladder/sex. Function improvement	3	6
Stop deformity progression	1	2
Approach		
Anterolateral	4	8
Posterolateral	4	8
Posterior midline	42	84
Morbidity State		
ASA 1	29	58
ASA 2	15	30
ASA 3	6	12
Technology used		
Microscope	25	50
O-arm	22	44
Computer assisted (Navigation)	1	2
Neuromonitoring	2	4
Operation time		
<1 hour	1	2
1-2	3	6
2-3	9	18
3-4	10	20
4-5	19	38
5-6	5	10
6-7	3	6
Blood loss		
100-500 ml	9	18
500-1000 ml	13	26
1000-2000 ml	23	46
>2000 ml	7	14
Blood transfusion		
None	37	74
<2 units	4	8
≥2 units	9	18

Table III: Data Derived from “Surgical Measures” Part of the Spine Tango Surgery Form

	n	% of cases
Decompression		
None	5	10
Anterior	4	8
Posterior	14	28
Both	27	54
Decompression Method		
Laminectomy	32	64
Flavectomy	31	62
Facet joint resection partial	26	52
Foraminotomy	25	50
Discectomy	23	46
Vertebrectomy partial	12	24
Facet joint resection full	8	16
Hemilaminectomy	9	18
Sequestrectomy	4	8
Tumor decompression	4	8
Ligamentotaxis (Recorded as other)	3	6
Uncoforaminotomy	2	4
Osteotomy	1	2
Fusion promoting measures		
None	0	0
Anterior	6	12
Posterior	41	82
Both	3	6
Fusion Material		
Bone substitute	43	86
Autol. Bone locally procured	35	70
Autol. Bone harvested	1	2
Cement	1	2
Stabilization rigid		
None	1	2
Anterior	5	10
Posterior	40	80
Both	4	8
Rigid stabilization method		
Pedicle screw with rod	43	86
Plates	6	12
Interbody stabil. With cage	5	10
Vertebral body replacement by cage	4	8
Lateral mass screw with rod	1	2
Extent of surgery (Number of levels that were incorporated to fusion or number of segments that undergo surgical intervention)		
Mean		3.6
Std. Deviation		1.17
Median		3
Range		2-6

Table III: Cont.

	n	% of cases
Intraop surgical complications		
Dura lesion	4	8
Other		
Implant malposition (Corrected at the same session)	4	8
Wrong level (Corrected at the same session)	1	2
Pneumothorax	1	2
Intraop general complications		
Anaesthesiological	1	2
Pulmonary	1	2
Other		
Neuropraxia	1	2

Table IV: Data Derived from “Hospital Stay” Part of the Spine Tango Surgery Form

	n	% of cases
Postop surgic. compl. before discharge		
Implant malposition	3	6
Motor dysfunction	2	4
Radiculopathy	1	2
CSF leak	1	2
Other hematoma	1	2
Reintervention after index surgery (During same hospitalization)		
Hematoma evacuation	1	2
Hardware re-implantation	3	6
Hospital stay		
Uneventful	40	80
ICU > 2 days	1	2
Extended stay	9	18
Status of surg. complications		
No complication	35	70
Resolved	4	8
Improved	6	12
Persisting	5	10

Like most of the world, Turkey also needs such medical registry systems. Although there have been previous attempts to establish such a system in our country (5), no system similar to Spine Tango is in current use. Because of Spine Tango's established efficacy and 10 years of history, we thought that translation of the Spine Tango forms into Turkish could increase its usage and help Turkey physicians collect data and analyze their own results. With its growing population of over 75 million people, Turkey is one of the biggest “developing countries”, with great potential to produce valuable medical data. The spine interventions in our country are mainly performed by neurosurgeons as well as by a limited number

of orthopedic surgeons. Except in deformity cases, most of the spinal surgeries are performed in neurosurgery clinics. Although there have been various joint attempts, currently there is no “spine surgery” training program providing solely spinal education to residents or fellows. In an environment such as that, Turkish Spine Tango may provide invaluable data and promote the development of spinal surgery in our country. In addition to aiding education, a registry system such as Spine Tango may permit comparisons among clinical management protocols of different clinics. It may also lead to protocol changes based on the evaluation of large-scale data on performance and hazards of interventions.

The current study was undertaken to demonstrate that the Spine Tango forms can be used in the context of Turkish spinal surgery. Our experience with Spine Tango forms during this past year was promising and largely successful. However, we did encounter some problems. A major drawback of this study was its local nature. The main obstacle that we encountered was concern about transferring local, private data to a remote server in another location. This problem stemmed from current medico-legal concerns in our country; however, this problem revealed its own solutions. The original Spine Tango system was structured for secure online data entry and statistical analyzes. Without this feature, the workload required by the current Turkish version of the registry is increased; however, we solved this problem with the help of today's software and mobile technologies, as explained above. We were able to successfully develop a simple and feasible computer-based solution to aid the process. The first suggestion of our Spine Tango team was to develop a more flexible infrastructure. For physicians who do not want to use a remote service, local solutions based completely on current forms should be developed. Mobile applications (i.e. iOS and Android applications that can be used with handheld tablets) may increase the usage of the system.

We are aware of the importance of centralized international data registries. Pooling data from all over the world may increase medical knowledge in a rapid and more accurate way. Although this paper demonstrates a limited, local experience, we believe that the proposed infrastructure in this study may serve as a starting point for development of large scale registry system in our country.

Additionally, we suggest the following changes be made to the forms:

1. For the section regarding “technology”, an option for the O-Arm (or similar real-time imaging modalities) and Spinal Navigation should be included. These systems are widely available today and have a great potential for improving patient management.
2. We feel that an option for preoperative and postoperative neurological examination should be included as well. We realize that a thorough examination report will not serve to the purpose of the system and will produce unnecessarily longer forms. However, a simple documentation of the patient's neurological status including key muscles and dermatomes can provide relatively quantitative data.

Table V: Data Derived From “Hospital Stay” Part of the Spine Tango Surgery Form

Follow-up time (months)			n % of cases	
Mean	3.9			
Std. dev	1.9			
Median	3.6			
Range	0.6-7.7			
			n	% of cases
Work status				
Housewife	19	38		
Not at work since op	15	30		
Retired before op	8	16		
Fully reintegrated	3	6		
Resumed work, different job	2	4		
Started partially, same job	1	2		
Child/student	1	2		
Therapeutic goals/measures achieved				
Spinal stabilization	46	92		
Axial pain relief	19	38		
Peripheral pain relief	29	58		
Functional improvement	23	46		
Motor improvement	7	14		
Sensory improvement	1	2		
Diagnostic	4	8		
Prophylactic decompression	3	6		
Bladder/sex. Function improvement	0	0		
Stop deformity progression	1	2		
Therapeutic goals/measures partially achieved				
Spinal stabilization	0	0		
Axial pain relief	21	42		
Peripheral pain relief	5	10		
Functional improvement	5	10		
Motor improvement	10	20		
Sensory improvement	5	10		
Diagnostic	0	0		
Prophylactic decompression	0	0		
Bladder/sex. Function improvement	0	0		
Stop deformity progression	0	0		
Therapeutic goals/measures not achieved				
Spinal stabilization	0	0		
Axial pain relief	4	8		
Peripheral pain relief	1	2		
Functional improvement	1	2		
Motor improvement	3	6		
Sensory improvement	2	4		
			n % of cases	
Diagnostic			0	0
Prophylactic decompression			0	0
Bladder/sex. Function improvement			3	6
Stop deformity progression			0	0
Medication for spinal surgery/pathology				
None			32	64
NSAII			12	24
Other			7	14
Antibiotics			5	10
Antidepressants			1	2
Opiates			1	2
Rehabilitation				
None			7	14
Home based			31	62
Outpatient rehab/physio			6	12
Inpatient rehab/physio			6	12
Overall outcome (Examiner)				
Poor			7	14
Fair			0	0
Good			17	34
Excellent			26	52
Complication (Reported or realized at follow up visit)				
Yes			14	28
No			36	62
Complication time				
Early, op-day-28 days postop			14	28
Sub-acute, 2-6 months			0	0
Late, >6 months			0	0
Complication type				
Wound infection superficial			8	16
CSF leak			6	12
Wound infection deep			3	6
Recurrence of symptoms			1	2
Motor dysfunction			1	2
Implant malposition			1	2
Sensory dysfunction			1	2
Other				
Secondary gain			1	2
Therapeutic consequences				
Reintervention			4	8
Non operative inpatient			1	2
Non operative outpatient			9	18

3. An option for emergent surgeries should be used to differentiate elective and emergent cases.
4. We suggest changing the “tumor localization” section of the surgery form to use the Weinstein-Boriani-Biagini staging system (1) to provide a more scientific classification.
5. We had two trauma cases with a CSF leak due to a tear in the dura that resulted from the trauma itself. An option to specify this type of pathology may help to differentiate surgical complications from traumatic ones.
6. An option for cases requiring instrument lengthening should also be added.
7. The difference between “posterolateral fusion” and “posterior fusion” is unclear. The “Spine Tango Dictionary of Terms” file also does not help. These terms should be clearly defined.
8. Parameters regarding spinal measurements such as sagittal balance, Cobb angle or scoring systems for determining radiological instability should be added to the forms. In our opinion, this may add some radiological classification information to the current clinically based system.

The suggested success rate calculation in this paper takes only achieved- and partially achieved therapeutic goals into account. We are aware that this approach is not sufficient and may not reflect patients’ perceptions of their final condition since complications, re-interventions and unreached goals were not considered. The effects of these problems during patient management may decrease the level of success obtained from a patient’s perspective. However, we believe that this approach attempts to provide a quantification-based approach to assessing the achievement of treatment goals and should be used instead of a completely subjective physician-based judgment. To determine the success rate in a more scientific way, we suggest using health-related quality-

of-life measures for patients. We are currently developing similar setups as those explained in this paper for established quality-of-life measurement batteries (i.e. EuroQol 5D, Oswestry Disability Index). A study is in progress to validate Turkish versions of core outcome measures index batteries.

With the current Turkey Spine Tango system, we collected valuable data from 50 patients. Now, we can clearly and easily see every relevant parameter regarding our patients’ pathologies and final results without the need of a cumbersome archive search process. Completing the forms, which requires only a few minutes, does not add any additional burden to the clinical workload. In fact, it reduces the time required to analyze patient data, potentially facilitating academic and scientific research. We recommend that every colleague performing spinal surgeries use Spine Tango forms.

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*Supplemental Digital Contents are available in the online version of the paper.