



## Predictive value of Tokuhashi and Tomita scores in patients with metastatic spine disease

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**Objective:** Our aim was to determine the best preoperative prognostic score to safely propose operative intervention for patients with metastatic spinal disease.

**Methods:** This prospective cohort study included 52 consecutive patients who underwent surgery between 1997 and 2007 to alleviate pain and preserve or restore neurological function. All patients were prospectively evaluated with the Tokuhashi score and retrospectively with the Tomita score to compare their surgery indications. The relationship between the scores and overall survival time were compared. P values of less than 0.05 were considered significant.

**Results:** In predicting survival time, the Tokuhashi score was statistically significant ( $r=0.574$ ,  $p=0.01$ ), and the Tomita score borderline significant ( $r=-0.394$ ,  $p=0.05$ ). For overall survival after initial diagnosis, the Tokuhashi score was borderline significant for survival ( $r=0.380$ ,  $p=0.05$ ) and the Tomita score was not significant.

**Conclusion:** The prognostic Tokuhashi score appears to be more valuable for surgical indications than the Tomita score in patients with spinal metastases.

**Key words:** Spinal metastasis, Tokuhashi score, Tomita score.

Metastatic spine involvement is most common in primary tumors of the breast, lung, kidney, thyroid, and prostate. It occurs in up to 40% of patients with cancer and approximately 70% of such patients have evidence of metastatic disease at the time of their passing.<sup>[1]</sup> Up to 5 to 20% of cancer patients may suffer spinal cord compression during the course of their disease. Recent improvements in overall survival due to advances in chemotherapy and radiotherapy have increased the frequency in which these cases are referred for a spinal opinion.<sup>[2,3]</sup>

For most surgeons the management of metastatic spinal disease remains palliative. Treatment aim is pain control and the preservation or restoration of function,<sup>[4]</sup> and is achieved by aggressive decompression of the cord from the site of major compression, followed by stabilization using metallic implants. Better outcomes have been achieved compared to the previous strategy of irradiation and simple laminectomy.<sup>[5]</sup> However, enthusiasm for such procedures has been tempered by increased morbidity and mortality. Questions remain whether early radical surgery can prolong life expectancy.<sup>[6,7]</sup>

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The 1996-7 report of NCEPOD (National Confidential Enquiry into Patient Outcome and Death, UK) indicated the need for a review of the referral and treatment pathway. Use of the Tokuhashi prognostic score was proposed to help in a more logical, safer and reproducible approach with the indications and the extent of the surgery.<sup>[8]</sup>

The Tokuhashi scoring system for patients with spinal metastasis was developed in 1990 and provides a method based on metastatic tumor prognosis to guide the extent of operation.<sup>[9]</sup> Parameters and respective scores are in Table 1, and interpretation of the scores in Table 2. In 2001, Tomita et al. launched an alternative prognostic score, aiming to take into account tumor histology and its biological behavior.<sup>[10]</sup> Parameters are presented in Table 3 and interpretation in Table 4. The Tomita score focuses relatively more on the survival than the Tokuhashi score. Both scores were based on fairly large retrospective series.

Through our own audit of patients with metastatic spine tumors, we discovered that the referral rate was low, referred patients were in a compromised physical condition, indications for referral were not standard and the results of surgery were considered to be unpredictable and was therefore often discredited (SLP audit at MGH – JCUH 1997, personal communication).

A prospective audit of the care pathway for metastatic spinal disease patients was undertaken to improve the care of our prospective patients. Our initial aim was to predict the suitability of individual patients for operative intervention. We wondered if we could predict survival for individual patients and examine the role of the referral pattern in survival, and the timing, approach and extent of surgery and the appropriate intervals between modalities of treatment. In this present study, we aimed to prospectively compare the prognostic strength of the two scores.

## Patients and method

The study included 52 consecutive patients (23 male, 29 female) with vertebral metastases of different primaries who were operated on for pain control and progressive neurological deficit between 1997 and 2007 by the senior author. Patients were referred when all other methods of treatment were ineffective to control symptoms.

Mean age of the patients was 60.7 (range: 41 to 85) years. The Tokuhashi score was applied prospectively, following the suggestion of the NCEPOD report. The Tomita score was retrospectively applied using all the

**Table 1.** The Tokuhashi scoring system for the preoperative evaluation of metastatic spine tumor prognosis.

Prognostic factor	Score
General condition (performance status according to Karnofsky)	
Poor (10%-40%)	0
Moderate (50%-70%)	1
Good (80%-100%)	2
No. of extraspinal bone metastases foci	
≥3	0
1-2	1
0	2
No. of metastases in the vertebral bodies	
≥3	0
2	1
1	2
Metastases to the major internal organs	
Irremovable	0
Removable	1
No metastases	2
Primary site of cancer	
Lung, stomach	0
Kidney, liver, uterus, unidentified, other	1
Thyroid, prostate, breast, rectum	2
Spinal cord palsy	
Complete	0
Incomplete	1
None	2

**Table 2.** Interpretation of Tokuhashi score.

Score	Action
9 -12	Radical surgery
6 - 8	Clinical judgment
0 – 5	Palliative management

data from hospital notes and the prospective audit database. All patients underwent standard preoperative assessment. Plain radiographs of the affected spinal segment, computed tomography of the affected segment and MRI of the whole spine were taken to clarify the local architecture, the extent of the metastatic spine involvement and the degree of neural tissue compression. A systemic investigation for sites of other metastases included physical examination, computed tomography of the chest and abdomen for detection of extra-spinal metastases and at times plain radiographs of the skeleton.

Management strategy was based on: (1) the treatment goal (i.e. anterior or posterior cord decompression followed by appropriate site stabilization if need-

ed), (2) the life expectancy of each individual patient as reported by the referring oncologist, (3) the appropriate Tokuhashi score for each individual patient, and (4) a discussion of each patient's wishes during the Consent Procedure.<sup>[11]</sup>

The appropriate surgical treatment was selected for each patient individually, based on the Tokuhashi prognostic score and the patient's wishes. Early on, we realized that from all the parameters of the score, the Karnofsky Performance Status (PS) played a major role in our "intuitive" offer or non-offer of surgery. As such, patients with a very low PS and low Tokuhashi score were either not offered surgery, or offered a palliative procedure, mainly for pain.

Although the usual reported outcomes for a study of this nature are pain relief (Visual Analog Scale, VAS) and postoperative neurology (American Spinal Injury Association, ASIA score), we decided to include the overall postoperative survival (months).

Results were presented regularly in audit meetings in the hospital to all involved departments (i.e. oncology, hematology, orthopedic surgery, and neurosurgery) for update and education.

The use of Tomita score was not encouraged in general in the UK. The idea of its use sprang from observations made during the period of the study and influence of the biology of the primary tumor. As such, it was applied retrospectively following study of the clinical notes of the same group of patients and assuming that the decision to operate or not would be the same.

All data were entered into an Excel database. Statistical analysis was performed using the Pearson product-moment correlation coefficient. P values of <0.05 was considered significant.

## Results

All 52 operated patients were included in this study. An additional 11 patients who either refused to have any operative intervention or were not considered suitable for one, mainly due to their overall physical status, were excluded. Mean age of the patients was 60.7 (range: 41 to 85) years. The vast majority (48 patients) had prior treatment for their primary tumor. The primary tumor was breast cancer in 30% of the patients. Primary tumor distribution is listed in Table 5. The cervical spine was involved in 10 patients, the thoracic spine in 37, and the lumbar spine in 18 patients. In 15 patients there was infiltration in more than one area of the spine (Fig. 1).

**Table 3.** Scoring system according to Tomita et al.

Prognostic factor	Score
Grade of malignancy	
Slow growth	1
Moderate growth	2
Rapid growth	4
Visceral metastases	
None	0
Treatable	2
Untreatable	4
Bone metastases	
Solitary or isolated	1
Multiple	2

**Table 4.** Interpretation of Tomita score.

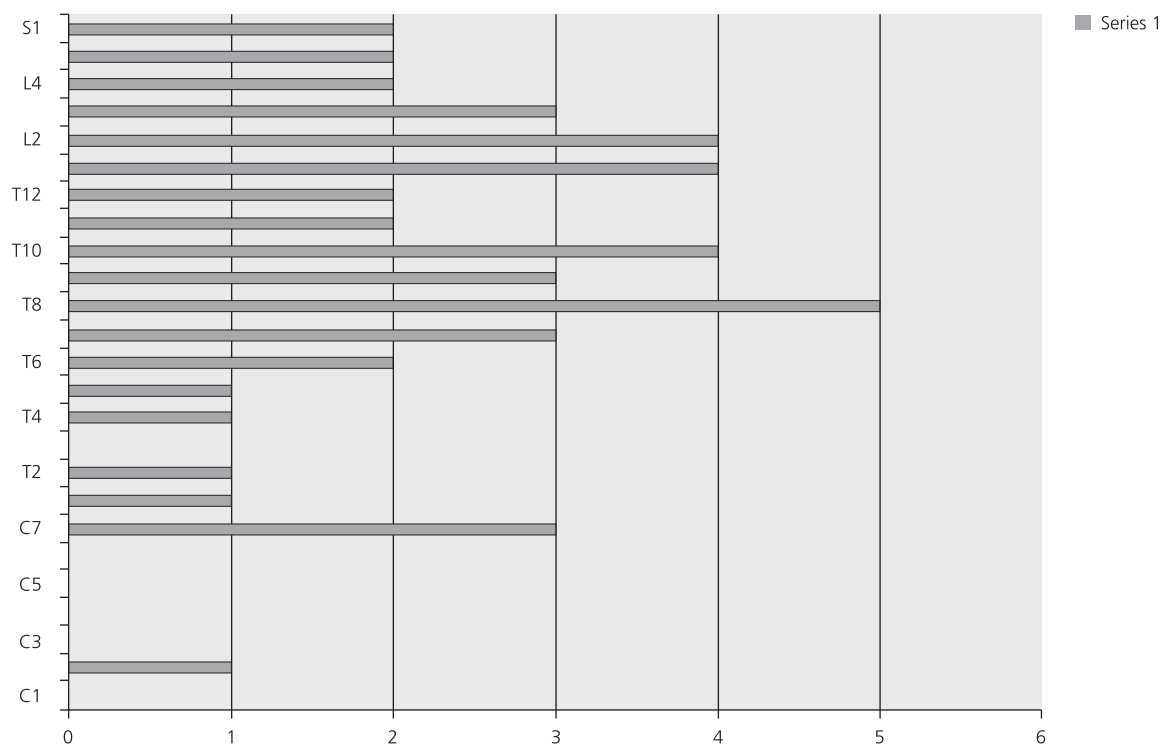
Score	Action
2-3	Radical surgery
4-5	Marginal / intralesional excision
6-7	Palliative surgery
8-10	Non-operative treatment

**Table 5.** Primary tumor distribution.

Site	No. of patients
Myeloma	5
Breast	16
Prostate	3
Renal	5
Lung	4
Thyroid	1
Ovaries	2
Nerve sheath sarcoma	1
Lymphoma	3
Others	12
Total	52

For all patients, both the Tokuhashi and Tomita scores were calculated. Most patients were in the "clinical judgment" group for both scores (Fig. 2). The Tokuhashi score was used as a guide in the decision to operate on 36 patients (69.23%). Twenty-five patients underwent a single posterior approach, 4 patients an anterior procedure and 7 patients a combined anterior-posterior procedure. The anatomical compression site or the infiltration was often not addressed directly and in that we were guided by the relatively low PS and Tokuhashi scores.

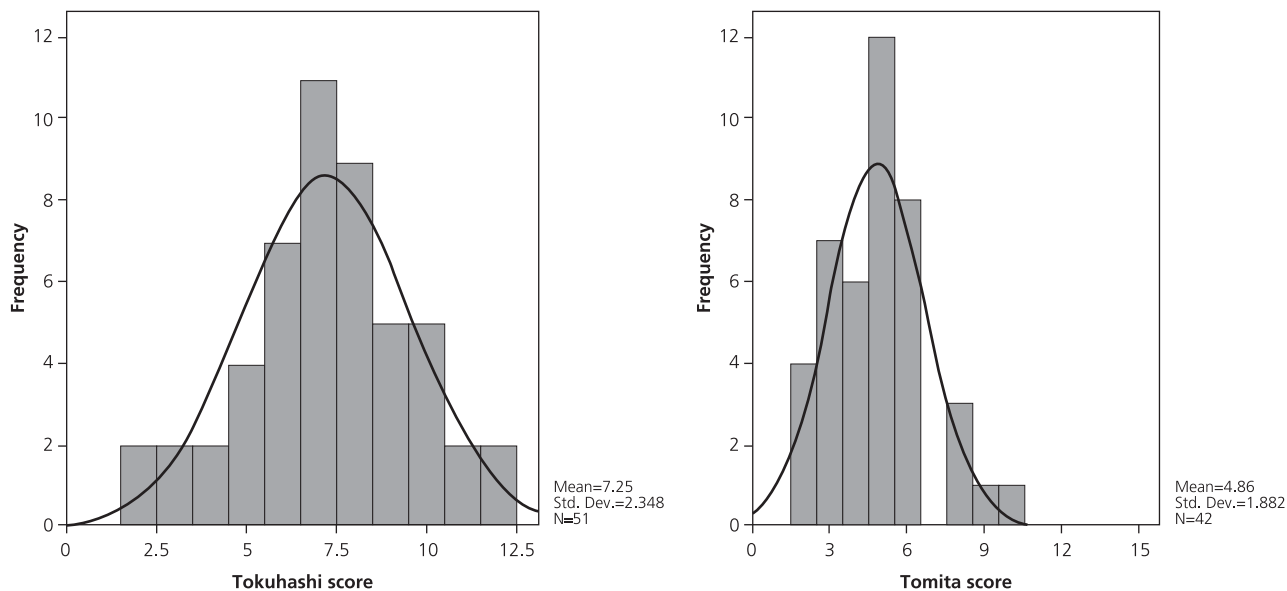
The operative goal of relieving pain and improving neurology was achieved in 94% and 87% of patients,



**Fig. 1.** Sites of metastases.

respectively (Figs. 3 and 4). The perioperative mortality in our study group was 5.55% (Table 6). Major complications, such as intraoperative bleeding and wound dehiscence, were found in 1.11% and 2.77% of patients, respectively.

The Tokuhashi score was statistically significant in predicting survival (Pearson correlation coefficient=0.574, p=0.01) and the Tomita score was borderline significant (correlation coefficient=-0.394, p=0.05). For overall survival after initial diagnosis, the Tokuhashi



**Fig. 2.** Frequencies in Tokuhashi & Tomita scores.

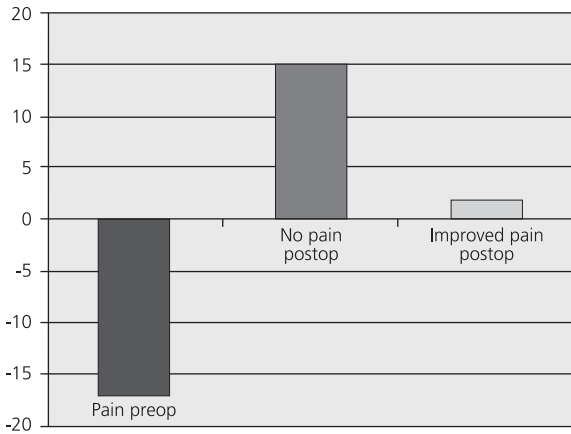


Fig. 3. Pain relief.

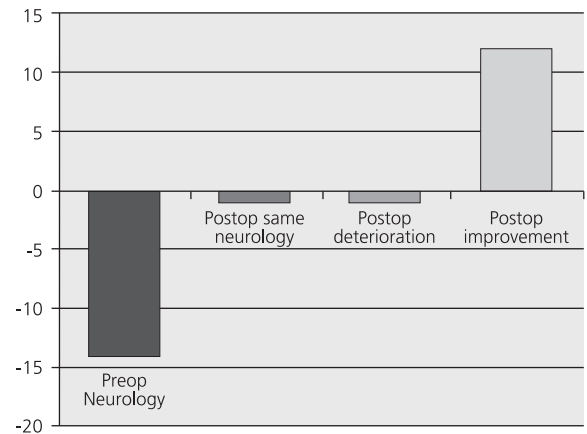


Fig. 4. Neurological improvement.

score was borderline significant for survival (correlation coefficient=0.380, p=0.05), whilst the Tomita score was not significant (Fig. 5).

**Discussion**

The decision making process for patients with metastatic spinal disease is difficult. The surgeon must take into account the aim of the intended operation (to counteract pain and preserve or restore neurological function) and the physical ability of the individual patient to withstand such an operation.<sup>[12]</sup> The initial enthusiasm for newer operative techniques in recent years has been contradicted by findings of increased morbidity and mortality in the literature.<sup>[13,14]</sup> As indicated by the NCE-POD Report (1996-7) and Glare et al., decisions based on a reported life expectancy and the feasibility of an operative approach is no longer prudent.<sup>[8,15]</sup>

Table 6. Complications.

	No	%
Intraoperative bleeding	4	1.11
Wound dehiscence	1	2.77
Death	2	5.55

The Tokuhashi and Tomita prognostic scores suggest a reduction of the uncertainty of decision-making. The original Tokuhashi score attempted to address the radicalism of the operation, making survival a prerequisite.<sup>[9]</sup> The Tomita score takes into account the biology of the primary tumor but also considers survival a prerequisite.<sup>[10]</sup>

The present study compared the relation between the two scores and the survival rate of patients who were operated.

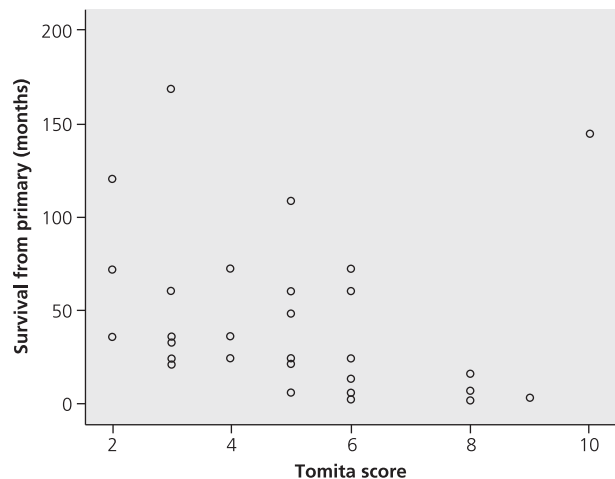
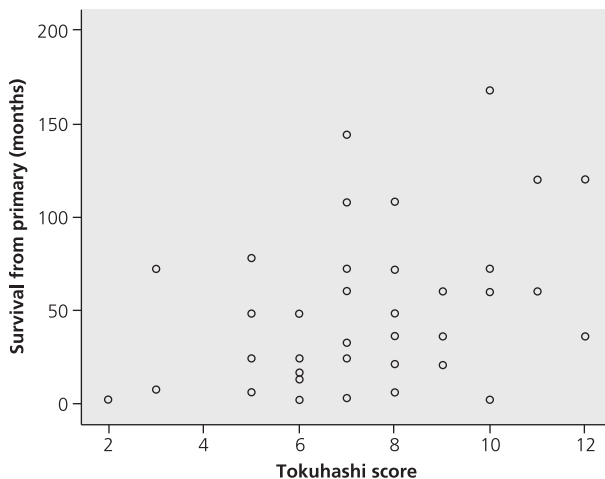


Fig. 5. Influences of Tokuhashi & Tomita scores.

Based on the data for surgical decision-making in our group of patients with spinal metastases, the Tokuhashi prognostic score appears to link more accurately with actual survival of the patients than the Tomita score.

Other authors have confirmed both this conclusion and the NICE (The National Institute of Health and Clinical Excellence) guidance on the subject.<sup>[16-20]</sup>

Ulmar et al.<sup>[16,17]</sup> retrospectively evaluated the prognostic value of the Tokuhashi and Tomita scores in 37 patients with spinal metastases secondary to renal cancer. The Tokuhashi score was found to provide very reliable results with a statistically high significance whereas analysis according to the Tomita score showed no correlation between predicted and real survival.

In another study, Enkaoua et al.<sup>[18]</sup> found that the Tokuhashi score could predict postoperative survival in patients with most metastatic tumors of the spine. However, vertebral metastases of unknown primary tumors had a poorer outcome than predicted and the authors suggested ascribing a lower score to patients in this group. Adenocarcinoma of unknown origin has been particularly lethal and with survival periods frequently less than 3 months.<sup>[19]</sup> In our study, we found only one patient with an unknown primary tumor and a Tokuhashi score of 7. This patient passed away 3 months after the operation.

There were four main limitations to our study. Firstly, the Tokuhashi score is applied prospectively and the Tomita retrospectively. A double-blind study, however, while allowing for a more scientific comparison, might necessitate the comparison with a control group of intuitive decisions alone. Secondly, the two scores aim at relatively different directions; one towards the extent of surgery, and the other towards biological behavior. Thirdly, as a retrospective study, there was no guarantee that the same decision would have been made had the authors relied on the Tomita score alone.

Finally, our study group consisted of patients with different primary tumors with different biologies. Considering the difficult for one center alone to gather a statistically sufficient sample of any group of patients with the same primary tumor, a multi-centric study might provide better results.

The advantage of our study was that the Tokuhashi score alone was applied prospectively following a long period of observation (10 years), which is to our knowledge unique.

We used the original Tokuhashi score, as it was the only available score at the time. Changing to the newly available Tomita or revised Tokuhashi scores would be counterproductive in the middle of the study.

Comparison of the results of both scores with individual parameters, such as the primary tumor (breast, lung, thyroid, kidney, etc.) location may be useful. However, in our study, the number of patients with each primary tumor type was not sufficient for such a statistical analysis.

The difference between the two scores in predicting survival was not great. The Tokuhashi score failed to produce statistical significance earlier on in the study (SLP personal communication 2001, 2004) when the number of patients was less than 40 in total. This suggests that the role of either score in the prediction of survival is limited and therefore the use of such a score alone in the decision making process is not entirely appropriate. It is possible that some parameters within each score have more relative weight than others, which are now considered of equal validity/importance. A prospective long-term study with the application of both scores in a combination pattern and assessment of individual parameters for specific group of primaries might be a valid suggestion for future research.

In conclusion, surgery in metastatic spinal disease is high-risk and careful patient selection is necessary to achieve the optimum outcome. The Tokuhashi score seems to be more predictive of postoperative survival than the Tomita score and its use in the decision-making in the management of metastatic spinal disease is recommended.

**Conflicts of Interest:** No conflicts declared.

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