

# A comparison of the modified Tokuhashi and Tomita scores in determining prognosis for patients afflicted with spinal metastasis

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**Background:** The prognosis of patients with spinal metastasis is not very promising and hard to predict. It is for this reason that scoring systems, such as the modified Tokuhashi and Tomita scores, have been created. We sought to determine the effectiveness of these scores in predicting patient survival.

**Methods:** We retrospectively reviewed the data of all patients treated for spinal metastasis between March 2003 and March 2012 in our centre. We computed the Tokuhashi and Tomita scores and compared them with documented patient survival. The 2 scores were also compared with one another.

**Results:** We identified 128 patients with spinal metastasis. The average survival of patients with predicted poor, average and good prognosis was 5, 17 and 25 months, respectively for the modified Tokuhashi score and 3, 16 and 19 months, respectively, for the Tomita score. Poor, average and good prognosis predictions differed significantly from one another for all 3 categories for the Tokuhashi score (all  $p < 0.05$ ). There was no significant difference in the moderate and good prognoses for the Tomita score ( $p = 0.15$ ). When comparing both scores, we obtained a weighted  $\kappa$  of 0.4489 (standard deviation 0.0568, 95% confidence interval 0.3376–0.5602), demonstrating moderate agreement between scores.

**Conclusion:** Both scores have merit for use in a clinical setting and can be used as tools to help determine treatment choice. The modified Tokuhashi score had better accuracy in determining actual survival.

**Contexte :** Le pronostic des patients qui ont des métastases vertébrales est plutôt défavorable et difficile à prédire. C'est pour cette raison que des systèmes de classification tels que le score modifié de Tokuhashi et le score de Tomita ont été créés. Nous avons voulu déterminer l'efficacité de ces scores à prédire la survie chez les patients.

**Méthodes :** Nous avons passé en revue de manière rétrospective les données concernant tous les patients traités pour métastases vertébrales entre mars 2003 et mars 2012 dans notre centre. Nous avons calculé les scores de Tokuhashi et de Tomita et nous les avons comparés à la survie documentée des patients. Les 2 scores ont aussi été comparés l'un à l'autre.

**Résultats :** Nous avons recensé 128 patients atteints de métastases vertébrales. La survie moyenne des patients dont le pronostic prévu était défavorable, moyen ou favorable était de 5, 17 et 25 mois, respectivement, selon le score modifié de Tokuhashi et de 3, 16 et 19 mois, respectivement, selon le score de Tomita. Les prédictions pronostiques défavorables, moyennes et favorables ont différé significativement l'une de l'autre pour les 3 catégories du score de Tokuhashi (toutes  $p < 0,05$ ). On n'a noté aucune différence significative pour ce qui est des pronostics moyens et favorables associés aux scores de Tomita ( $p = 0,15$ ). Lorsque les 2 scores ont été comparés l'un à l'autre, nous avons obtenu une valeur  $\kappa$  de 0,4489 (écart-type 0,0568; intervalle de confiance de 95 %, 0,3376–0,5602), associée à une concordance modérée des scores.

**Conclusion :** Les 2 scores sont utiles dans un contexte clinique et peuvent servir d'outils pour aider à faire le choix du traitement. Le score modifié de Tokuhashi a permis de déterminer la survie réelle avec plus de précision.

The prognosis of patients with spinal metastasis is not very promising and difficult to predict. These metastases are very common manifestations of bone metastasis<sup>1,2</sup> and normally originate from 5 classic primary sites: the kidneys, breasts, prostate, lungs and thyroid.<sup>3</sup> Although the primary site can help determine the aggressiveness of the disease, it still is very difficult to predict patient prognosis. It is for this reason that scoring systems have been devised to help determine patient survival.<sup>4</sup> Of these scoring systems, the Tomita and modified Tokuhashi prognosis scores have become very popular and are used to determine optimal patient treatment.<sup>4</sup> The Tomita score, introduced in 2001, is composed of 3 parameters based on tumour growth, visceral metastases and number of bone metastasis lesions (Table 1).<sup>5</sup> The Tokuhashi score was first introduced in 1990<sup>6</sup> and revised in 2005.<sup>7</sup> This scoring system is based on 6 parameters, including patient condition, location of metastasis and the site of primary cancer (Table 2). These scores intend to predict patient prognosis to help physicians choose the optimal treatment. With the improvement of treatment modalities over the years, physicians can offer many procedures to their patients, including radiotherapy, chemotherapy and surgery. The choice of surgery versus other treatments can be hard to determine, and surgeons tend to base their decisions on objective scores, such as the Tomita and modified Tokuhashi scores.

Patients with spinal metastasis who have good to moderate prognoses seem to benefit from more aggressive surgery.<sup>7</sup> Although still palliative in nature, surgery for patients with good prognoses can be more aggressive (i.e., larger excision), and more instrumentation can be warranted. In addition, patients with acceptable prognoses (> 3 mo) can still benefit from surgery for symptom relief and mechanical stability, whereas those with poor prognoses should be treated conservatively without surgery. Concordantly, Tomita and colleagues<sup>5</sup> and Tokuhashi and colleagues<sup>6,7</sup> suggested wide excision versus palliative surgery versus no surgery and supportive care based on

their scores and therefore prognosis. Although these scores are very beneficial, it is hard to know which score to use to determine treatment choice for our patients.

Ulmar and colleagues<sup>8</sup> conducted a study involving 37 patients with renal carcinoma metastasized to the spine and examined the effectiveness of the Tokuhashi and Tomita scores in predicting prognosis. According to their study, the Tokuhashi score was more valuable than the Tomita score for predicting survival.<sup>8</sup> We believe that including all primary sites is more representative of the true clinical use of the scores, which are used to determine prognosis of all patients afflicted with spinal metastasis, irrespective of primary site. In addition, the modified Tokuhashi score included more primary site divisions as part of their prognosis parameters. This study was conducted to determine the effectiveness of the modified Tokuhashi and Tomita scores in determining patient prognosis, irrespective of the primary cancer site, in the context of the practice at an oncology centre. We believe this is representative of the true clinical use of the scores, and we hope that our results can help clinicians decide which score to use to determine the appropriate treatment for their patients.

## METHODS

We conducted a retrospective review of all patients treated for spinal metastases between March 2003 and March 2012 in our centre. We reviewed patient data, including imaging (magnetic resonance images, computed tomography scans and plain radiographs), pathology and charts to determine

**Table 1. Tomita score**

Prognosis parameter	Score
Primary site	
Slow growth (breast, thyroid, etc.)	1
Moderate growth (kidney, uterus, etc.)	2
Rapid growth (lung, stomach, etc.)	4
Visceral metastases	
None	0
Treatable	2
Not treatable	4
Bone metastasis	
Solitary	1
Multiple	2

**Table 2. Modified Tokuhashi score**

Prognosis parameter	Score
Patient condition	
Poor (performance status 10%–40%)	0
Moderate (performance status 50%–70%)	1
Good (performance status 80%–100%)	2
No. of bone metastases outside spine	
> 2	0
1–2	1
0	2
Metastasis to major organs	
Nonremovable	0
Removable	1
None	2
Primary site	
Lung, osteosarcoma, stomach, bladder, esophagus, pancreas	0
Liver, gallbladder, unidentified	1
Other	2
Kidney, uterus	3
Rectum	4
Thyroid, breast, prostate, carcinoid tumour	5
Palsy	
Complete (Frankel A, B)	0
Incomplete (Frankel C, D)	1
None (Frankel E)	2

the Tomita and the modified Tokuhashi scores. We then compared these scores with the actual documented survival (i.e., documented death or last documented hospital visit). Scores were based on data present before treatment in order to assess the effectiveness of the scores in predicting survival. We noted the type of treatment received, including aggressive surgery, palliative surgery, chemotherapy, radiotherapy or a combination of these treatments. We included patients with all types of primary cancer sites, and only patients lost to follow-up were excluded.

### Statistical analysis

We performed standard Student *t* tests to determine whether differences in actual survival differed from one survival category to the next for each score; this was achieved by comparing patients with poor prognoses to those with good and moderate prognoses for each score. Thus, we were able to determine if differences in mean actual survival existed between categories, as classified by each score.

We assumed that each of the prognosis scores was scored by the given author (Tomita or Tokuhashi), and we compared the 2 scores with a weighted  $\kappa$  analysis to determine if the scores agreed with each other. To complete this analysis, we created a new common score to directly compare the 2 scoring systems (Table 3). This new score was based on poor, moderate or good prognosis, as defined by each author (i.e., based on each point system a new common score was created to compare the scores to one another). For the revised Tokuhashi score a good prognosis was defined as a score of 12 or greater, a moderate prognosis was defined as a score of 9–11 and a poor prognosis was defined as a score of 8 or less. Similarly, for the Tomita score a good prognosis was defined as a score of 2–4, a moderate prognosis was defined as score of 5–7 and a poor prognosis as a score of 8 or more. We defined a good prognosis as a survival of more than 12 months, a moderate prognosis as a survival of 6–12 months and a poor prognosis as a survival of less than 6 months.

## RESULTS

We identified 128 patients with spinal metastasis treated during our study period: 71 women and 53 men with an average age of 59.1 (range 30–89) years. Only 2 of these patients were lost to follow-up (undetermined reasons), leaving us with a final study sample of 126 patients. The overall average patient survival was  $16 \pm 13$  months. In all, 42 patients (33%) survived less than 6 months, 16 patients (13%) survived 6–12 months, and 68 patients survived (54%) more than 12 months. Patients with a modified Tokuhashi score of more than 11 (good prognosis) survived an average of 25 months, those with a score of 9–11 (moderate prognosis) survived an average of

17 months, and those with a score of 8 or less (poor prognosis) survived an average of 5 months. All 3 of these categories differed significantly from one another when it came to survival (all  $p < 0.05$ ; Table 4). In contrast, patients with a Tomita score of 2–4 (good prognosis) survived an average of 19 months, those with a score of 5–7 (moderate prognosis) survived an average of 16 months, and those with a score of 8–10 (poor prognosis) survived an average of 3 months. The good and moderate prognoses did not differ significantly ( $p = 0.15$ ). However, those with poor prognosis scores did differ significantly ( $p < 0.001$ ; Table 4) from those with moderate and good prognosis when it came to survival.

The results seen in the statistical analyses are also displayed graphically in Kaplan–Meir survival curves (Fig. 1). It is hard to clearly differentiate patients in the moderate and good prognosis categories for the Tomita score. In contrast all 3 categories of the modified Tokuhashi score can be clearly differentiated. It was easiest to differentiate those with poor prognosis from the rest of the patients for both scores. This is depicted in Figure 2, a histogram of the distribution of scores based on actual survival. Similarly, Tables 5 and 6 show the distribution of patients for each of the scores based on survival. Our results for the modified Tokuhashi score showed that 71% of patients who survived less than 6 months had a score of 8 or less and that 75% who survived more than 12 months had a Tomita score of 4 or less.

In addition, Table 7 shows the distribution of patients' primary cancer sites and the effective scores and survivorship based on the primary site alone. The primary site that was associated with the worst survival was the lungs, and the primary cancers associated with the best survival were breast cancer and multiple myeloma. Although included in both scores, the primary cancer site alone was not enough to help predict prognosis (Table 7).

**Table 3. New scoring system devised based on Tomita and modified Tokuhashi scores**

Prognosis	Tomita score	Tokuhashi score	New score
Good	2–4	12–15	1
Moderate	5–7	9–11	2
Poor	8–10	0–8	3

**Table 4. Modified Tokuhashi and Tomita scores based on prognosis category**

Score	Prognosis	Average survival, mo	<i>p</i> value
Modified Tokuhashi			
> 11	Good	25	0.003
9–11	Moderate	17	< 0.001
≤ 8	Poor	5	< 0.001
Tomita score			
2–4	Good	19	0.15
5–7	Moderate	16	0.15
8–10	Poor	3	< 0.001

To compare the scores to one another directly, we devised a new scoring system, as detailed in Table 3. The new scores were then compared directly to each other with a weighted Cohen  $\kappa$  analysis. The result obtained was a weighted  $\kappa$  of 0.4489 (standard deviation 0.0568, 95% confidence interval 0.3376–0.5602). This demonstrates moderate agreement between the scores.

## DISCUSSION

We analyzed the data from 126 patients with spinal metastases — a disease with prognosis that is hard to predict and for which many treatment options exist. Scores developed by Tomita and Tokuhashi are intended to help in the choice of treatment modality by predicting prognosis.

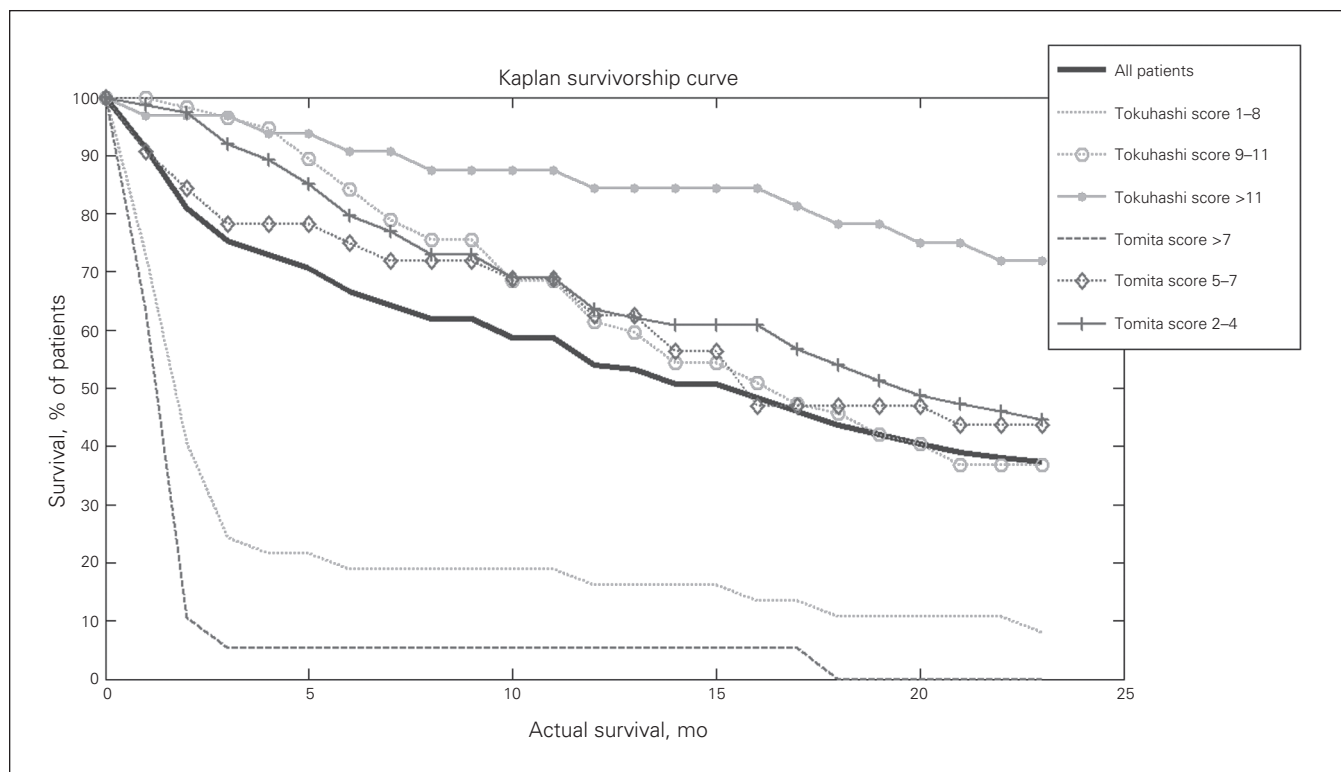


Fig. 1. Kaplan-Meier survivorship curve.

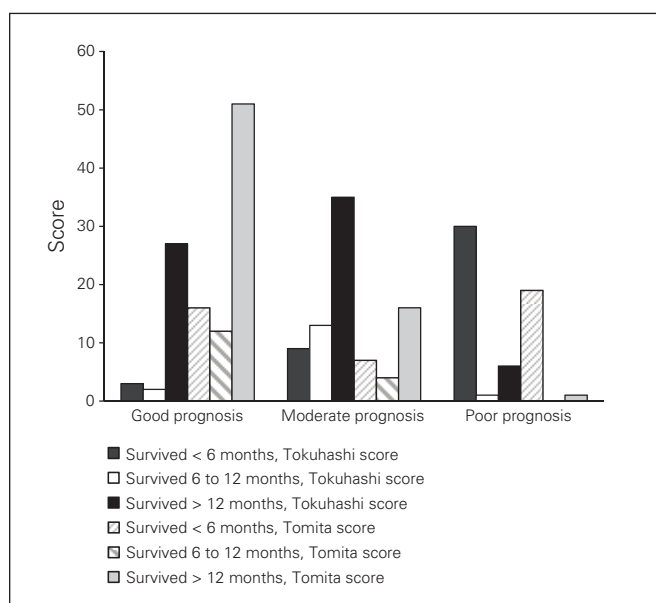


Fig. 2. Histogram of scores by category based on true survival.

Table 5. Number of patients with modified Tokuhashi score based on survival

Prognosis	Modified Tokuhashi score	Survival, mo; no.		
		< 6	6–12	> 12
Good	> 11	3	2	27
Moderate	9–11	9	13	35
Poor	1–8	30	1	6

Table 6. Number of patients with Tomita score based on survival

Prognosis	Tomita score	Survival, mo; no.		
		< 6	6–12	> 12
Good	2–4	16	12	51
Moderate	5–7	7	4	16
Poor	8–10	19	0	1

Of the treatment options available, surgery should be considered.<sup>9</sup> In fact, studies have demonstrated the positive outcomes of surgery for patients with spinal metastases.<sup>9,10</sup> However, surgery should be reserved for patients with moderate or good prognoses and should be avoided for those with poor prognoses.<sup>11</sup> Other studies, such as that by Kataoka and colleagues,<sup>12</sup> have demonstrated that primary tumour, metastasis to major organs and extra bone metastasis were the best predictors of survival. In the study by Leithner and colleagues,<sup>4</sup> 7 parameters that were thought to influence prognosis were analyzed. Of the 7, only the presence of visceral metastasis and primary site were shown to be significant predictors of prognosis.<sup>4</sup> In our study, instead of looking at each patient characteristic individually, we set out to determine whether the Tomita and modified Tokuhashi scores were accurate in predicting survival in our patients and whether these 2 scores are comparable to one another. To our knowledge, we are the first to present a large set of patient data comparing the Tomita and modified Tokuhashi scores, irrespective of primary cancer site.

We found that both scores were accurate in differentiating patients with poor prognoses from the rest. Our results also show that the modified Tokuhashi score was more accurate in differentiating between moderate and good prognoses. Comparing the 2 scores demonstrated that they had moderate agreement. Although there was no clear score that outperformed the other, we found that the Tokuhashi score was a better predictor of actual survival. The ultimate goal of a prognosis score is to help determine the best treatment for our patients. Since both scores allowed for a fairly accurate identification of patients with poor prognoses, we believe that both scores have merit for use in the clinical setting. If faced with patients with spinal metastases, a modified Tokuhashi score of less than 8 or a Tomita score of 7 or more should lead physicians to question whether surgery is appropriate. In such patients, we advise surgeons to be conservative and offer palliative treatment only.

For patients who have scores corresponding to moderate or good prognoses, it was not clear if a treatment choice based on the scores alone would be beneficial. In such patients we advise surgeons to consider the overall

clinical presentation, taking into account pain, neurologic deficit and biomechanical stability of the spine, in order to make the final treatment decision. We suggest considering the modified Tokuhashi score only after all other modalities do not help in the treatment choice. We also suggest conservative management of patients with spinal metastasis, as the rate of survival is, as expected, not very high (average of 16 mo in our patients). Surgical treatment should target biomechanical stability and pain relief as opposed to tumour excision.

## CONCLUSION

We studied 126 patients with spinal metastases originating from multiple primary tumour sites. We compared prognosis scores described by Tomita and Tokuhashi to actual survival. We observed that both the Tomita and the modified Tokuhashi scores were accurate in determining patients with poor prognoses (surviving less than 6 mo). Patients with a Tomita score of 7 or more survived an average of 3 months, whereas those with a modified Tokuhashi score of 8 or less survived an average of 5 months. Hence, we believe that both scores can be used clinically to identify patients who would best benefit from palliative care. For patients with moderate or good prognoses, the modified Tokuhashi score proved to be more accurate in determining actual survival. We suggest that clinical presentation (pain, neurologic deficit, biomechanical stability) should be considered in conjunction with the score to determine optimal surgical treatment. That is, the decision for surgery should never be based on a prognostic score alone but should take the overall clinical picture into account.

The average survival for all our patients was 16 months, showing that the survival of patients with spinal metastases is not very promising. Hence, we suggest surgery for biomechanical stability of the spine and pain reduction rather than surgery aimed at tumour excision.

**Competing interests:** None declared.

**Contributors:** Both authors designed the study, wrote the article and approved the final version for publication. A. Aoude acquired and analyzed the data, and L.-P. Amiot reviewed the article.

**Table 7. Primary cancer sites of patients included in our analyses**

Primary site	No. of patients	Average survival, mo	Average modified Tokuhashi score	Average Tomita score
Lungs	18	9	5.91	7.29
Kidneys	10	12	8.00	6.00
Uterus	2	13	9.00	5.50
Breasts	29	20	10.68	3.31
Thyroid	2	15	12.00	2.00
Prostate	4	13	11.75	3.75
Multiple myeloma	38	19	9.98	3.54
Other	23	13	7.64	6.23

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