

Transection of the filum terminale in occult tethered cord syndrome –analysis of intraoperative, imaging, and clinical findings [Abstract]

Xenia Hautmann, Christoph Bettag, Nadine Lilla, Micol Colosimo, Fares Komboz, Mohammad Hazaymeh, Tammam Abboud, Veit Rohde, Dorothee Mielke

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pressure >40 cmH₂O. Multivariable logistic regression evaluated associations between injury level (cervical/thoracic/lumbar), neurological severity (ASIA A–B vs C–D), age, sex, and time from injury to T1. Model performance was examined using Nagelkerke R^2 and area under the receiver operating characteristic curve (AUC). P value below 0.05 was considered significant.

Results: Among 297 patients (median age 33.6 years; 76% male), 65.7% demonstrated high-risk bladder at T1. The median time from injury to T1 was 16 months (IQR 5–192). After adjustment, ASIA A–B injuries were independently associated with high-risk bladder (OR 2.57, 95% CI 1.32–5.00, $p=0.005$). Conversely, injury level was not independently associated with marked bladder dysfunction (cervical vs thoracic: OR 1.3, 95% CI 0.69–2.47; lumbar vs thoracic: OR 0.97, 95% CI 0.34–2.84). Predictive value was moderate (AUC 0.67; 95% CI 0.6–0.74). In secondary analyses, ASIA A–B was strongly associated with poor compliance (OR 4.68, 95% CI 2.31–9.49; $p<0.001$) and vesicoureteral reflux (OR 3.42, 95% CI 1.12–10.44; $p=0.031$). Cervical injury was independently linked with poor compliance (OR 2.08, 95% CI 1.08–4.04; $p=0.029$). Age, sex, and time from injury were not independent factors.

Conclusions: High-risk bladder pathophysiology is highly prevalent at first urodynamic evaluation following traumatic SCI. Neurological severity, rather than anatomical injury level, is the principal determinant of adverse storage dysfunction. These findings support proactive urological surveillance in patients with SCI.

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1005

Oral e-Poster Presentations 2 - Booth 4, October 1, 2026, 1:00 PM - 2:00 PM

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Transection of the filum terminale in occult tethered cord syndrome – analysis of intraoperative, imaging, and clinical findings

Xenia Hautmann¹, Christoph Bettag², Nadine Lilla¹, Micol Colosimo¹, Fares Komboz², Mohammad Hazaymeh¹, Tammam Abboud², Veit Rohde², Dorothee Mielke¹

¹ University Hospital Augsburg, Göttingen, Germany; ² University Hospital Göttingen, Göttingen, Germany

Occult tethered cord syndrome (OTCS) is a rare condition that can cause a wide range of neurological symptoms. In contrast to tethered cord syndrome (TCS), it is difficult to detect on routine MRI. At two university hospitals, we defined a novel diagnostic and surgical standard and performed transection of the filum terminale (FT).

Methods: We retrospectively included patients who underwent surgery for OTCS between 01/2019 and 12/2026. Symptomatic patients were treated in whom a dorsal attachment of the FT could be demonstrated on prone-position MRI. Intraoperative observations and neuromonitoring (IONM) were analyzed. Fisher's exact test was used for categorical variables and the Mann–Whitney U test for continuous variables.

Results: A total of 43 patients were included. The most common levels of dorsal attachment were L3 (30.2%), and L3/4 (46.5%). In 34.9% of cases, more than one FT strand was identified (range: 1–4). The number of FT strands was significantly associated with the lumbar level of attachment ($p = 0.009$). Duplication of the FT on MRI was significantly associated with the detection of multiple FTs intraoperatively ($p=0.02$). Other MRI findings—including FT lateralization and the distance between the FT and cauda equina fibers—were not associated with the intraoperative number of FT strands ($p = 1.0$). Preoperative dysesthesia of the extremities was significantly associated with the detection of only one FT ($p=0.003$). In 7.3% of patients, adhesions between sacral bladder fibers and the FT were observed. This finding was associated with persistent postoperative bladder dysfunction ($p = 0.036$). No postoperative neurological deterioration occurred. There was no significant association between IONM and postoperative outcome or intraoperative findings.

Conclusions: This approach has not been described previously in the literature. Our findings regarding the presence of multiple FT strands and adhesions to sacral bladder fibers are of immediate clinical relevance.

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1131

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Multimodal Characterization Of The Immune Cell Composition Of Vertebral Body Metastases And Their Clinical And Therapeutic Relevance

Sven König¹, Jonathan Schupp², Karl Heinz Plate², Marcus Czabanka¹, Stefanos Voglis^{1,3}

¹ University Hospital, Goethe University Frankfurt am Main, Frankfurt am Main, Germany; ² Edinger Institute, Goethe University Frankfurt am Main, Frankfurt am Main, Germany; ³ University Hospital, University of Zürich, Zürich, Switzerland

The incidence of vertebral body metastases (VBM) is increasing due to advancements in systemic cancer therapies. However, prognosis remains poor, and predictive biomarkers for systemic therapy responses are limited. In several solid tumors, the density, composition, and spatial organization of tumor-infiltrating immune cells determine whether lesions are immunologically “hot” or “cold” and are associated with therapeutic efficacy, especially in the context of immune checkpoint inhibition. In contrast, the immune landscape of VBM and its clinical relevance remain largely unexplored. We hypothesize that distinct immune microenvironmental patterns exist in VBM that may stratify patients according to their response to immunomodulatory therapies.

Methods: We established a comprehensive clinico-pathological database of surgically treated VBM, including treatment regimens and outcome. In an exploratory cohort of untreated VBM (breast, lung, and prostate cancer), Xenium 5k spatial transcriptomics was performed on FFPE specimens to characterize tumor, immune, and stromal compartments at high spatial resolution. Computational analyses included inferring cell-type composition, clustering, and identifying spatially variable genes. Key immune phenotypes were validated on protein level in a larger, independent cohort using Imaging Mass Cytometry (IMC) with multiplexed single-cell resolution.

Results: Preliminary IMC data from calcified VBM tissue reveal significant inter- and intralesional heterogeneity of immune infiltrates. Variable densities of macrophages, granulocytes, and T-cell subsets were observed, suggesting immunologically distinct VBM phenotypes. Spatial transcriptomic analyses demonstrated profound functional and spatial differences between VBM entities and within individual lesions, indicating inter- and intralesional heterogeneity of the single-cell tissue architecture. Validation using a published scRNA-seq dataset of human spinal bone metastases confirmed multiple functional and cell–cell interaction patterns conserved across cohorts and technologies.

Conclusions: This multimodal spatial approach provides high-resolution characterization of the VBM immune microenvironment. Identifying immunologically “hot” vertebral metastases may enable biologically informed patient stratification, improving immunotherapy selection, and advancing precision oncology in spinal metastatic disease.

Optional Image

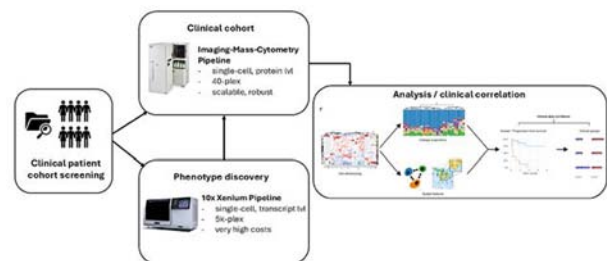


Figure 1: Analysis workflow

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