Subtleties of stabilization for multilevel metastatic lesion of spine

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INTRO

• In general, spinal stability is defined as the ability of the spine to resist physiologic loads without progressive deformity, incapacitating pain, or damage to neural elements.

• Restoration or maintenance of spinal stability is an important objective in the surgical management of patients with spinal neoplasms.

Fourney DR, Gokaslan ZL. Neurosurg Focus. 2003 Jan 15;14(1):e8

The effectiveness of radiation therapy and medication vs. surgical decompression in patients with spinal cord compression due to soft tissue component of the tumor and a stable spine

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<thead>
<tr>
<th>Research</th>
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<td>12</td>
<td>24</td>
<td>43</td>
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<td>201 ♂ ♀ Radiotherapy + medication + Surgery</td>
<td>35</td>
<td>87</td>
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Surgical activity for patients with spinal tumors (Vreden Institute 1998-2012) (n=1260)
Characteristic of histological types (n=1260)

- **Benign**: 907 (72%)
- **Primary malignant**: 252 (20%)
- **MTS**: 101 (8%)

**Breakdown by Location**

- **Breast**: 527 (58%)
- **Renal**: 145 (16%)
- **Lung**: 109 (12%)
- **Colorectal**: 36 (4%)
- **Ovary**: 18 (2%)
- **CUP**: 9 (1%)
- **Prostate**: 63 (7%)

**Breakdown by Single vs. Multiple**

- **Single**: 192 (21%)
- **Multiple**: 715 (79%)
Choice of fixation (stabilization) depends on:

• Histological type of tumor, general condition of patient, life expectancy
• Disturbance of bone mineral density
• Tumor dissemination (localization of lesions)
• Choice of implant
Osteoporosis and MTS are most common causes of vertebral body pathological fractures (Riggs BL, Melton LJ. 1995).

♀ 79 D: ThVI-VII-VIII osteoporotic fractures

♀ 51 D: MTS of the breast Cr, ThV, ThVIII-IX-X fractures
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<th>Versions of diffuse spinal metastatic lesion</th>
<th>Focal multiple</th>
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Choice of implant
Standard fixation for poor bone mineral density

• Implant depended complications: early – 13%; late – 37%

• Laminar fixation (wire, hooks) is not rigid and can’t corrected of imbalance plane when a patient has poor bone mineral density

• Standard transpedicular fixation is slightly effective and may be contraindication for patient with poor bone mineral density

DeWald CJ, Stanley T. Spine 1. 2006;31:144–151
В.Д. Усиков, Д.А. Пташников, М.Ю. Докиш Травматология и ортопедия России. – 2010. – № 3. – С. 28-34
Ways to improve the stability of the fixation under poor bone mineral density and MTS

Increase of bone strength

- Medical therapy
- Vertebroplasty (PMMA, bioresorbable materials)

Increase of implant stability at bone

- Biomechanic of fixation
- Correct choice of implant and method
  - Laminar and combined fixation
  - Design of screws
  - PMMA screws
  - Standard screws with vertebroplasty
Benefits of cement fixation

Stiffness perforated cement screws, their opposition distraction loads, 2.1-2.38 times higher than standard screws

![Graph showing dependence of dislocation screws on applied loads]

Dependence of the dislocation screws from the applied loads:

1- standard
2- perforated

А.А. Афаунов, В.Д. Усиков, Д.А. Пташников, К.К. Тахмазян, М.Ю. Докиш
Design of fixation
Long fusion without PMMA

Extra focal fixation.

Indications: - adjacent vertebrae with good BMD
- multilevel focal lesion
- polyfocal lesion

♀ 55 y.o., Ds: Cr coli uteri Mts, Pat. fracture ThXII, Ll. Paresis. Pain.
Long fusion without PMMA

Extra focal fixation.

Indications: - adjacent vertebrae with good BMD
- multilevel focal lesion
- polyfocal lesion
Long fusion with PMMA

Indications:
- adjacent vertebrae with poor BMD
- multilevel focal lesion
- polyfocal lesion
- total lesion

♀ 49 y.o., Ds: breast cancer. Mts, pat. fracture ThVII, VIII, XI. Osteoporosis
Long fusion with PMMA

Indications:
- adjacent vertebrae with poor BMD
- multilevel focal lesion
- polyfocal lesion
- total lesion
♀83 y.o. Ds: Multi MTS breast cancer, pat. fracture ThX with spinal cord compression, paraplegia
Pain (VAS) – 9; Neurological (Frankel) - B; Life quality (ODI) – 35%
Operation:
MISS decompression + PC SPS (Viper II) + PMMA
Operation:
MISS decompression +
PC SPS (Viper II) + PMMA

preOp
VAS – 9
Frankel – B
ODI – 35%

1 year postOp

3
D
60%
Short fusion with PMMA for diffuse metastatic lesions

♀ 57 y.o.
Ds: breast cancer. Mts, pat.fracture ThVI, VII. Pain.

♂ 41 y.o.
Dynamic of pain (pain scale P.C. McAfee, 1989) and fusion stability after operation

I group

II group

III group

N (%) reoperations:

12% - implant loosening

4% - cement leakage

3% - cement leakage
Conclusions

1. Surgical stabilization of spine is effective method for management of patients with diffuse metastatic spinal tumors

3. Choosing of stabilization depends on
   - Disturbance of bone mineral density
   - Tumor dissemination (localization of lesions)

3. Transpedicular fusion using a PMMA screws provides a stable and long-lasting effect

5. PMMA screws are reduce traumatic of surgery (fixation) with comparable effectiveness