Spinal augmentation

Spinal augmentation procedures (SAP) are standard procedures for vertebral compression fractures. Often, SAPs are carried out in a minimally invasive, percutaneous way. Certain anatomic conditions such as small pedicles or kyphotic deformities resulting from a significant collapse of the vertebral body might render the operation more difficult and increase the risk of complications. Thus, robot assistance might be useful to optimize the trajectory and to reduce procedure-associated complications. In this study robot-assisted percutaneous SAPs are compared with conventional fluoroscopy-guided percutaneous SAP.

A retrospective observational analysis was carried out. Standard demographic parameters were analyzed. Procedural data including radiation dosage records were screened. Biomechanical data were recorded. Cement volumes were analyzed. The precision of the pedicular trajectory was reviewed, and misplaced trajectories were categorized. Procedure-associated complications were analyzed and evaluated for their clinical significance.

A total of 130 procedures were reviewed, and 94 patients were finally included. Osteoporotic fractures (OF) were the main indication (60.7%; OF 2-44%, OF 4-33%). Demographic parameters and clinically relevant complications were equally distributed between the two groups. The duration of surgery was significantly longer in robot-assisted procedures ($p < 0.001$). Intraoperative radiation exposure was equally distributed. Injected cement volume was similar in both groups. There was no significant difference in pedicle trajectory deviation.

The use of robot assistance in SAP seems not to be superior with regard to the accuracy, radiation exposure, and the rate of complications when compared to fluoroscopy-guided SAP [1)].

Vertebral cement augmentation in the spine wherein “bone cement” is injected directly into a fractured vertebra with the intention of relieving back pain and getting patients back on their feet as soon as possible.

Modern, minimally invasive augmentation techniques represent a real alternative to conservative treatment of patients with vertebral fractures. Further technical and clinical development in this area should aim at optimizing procedural safety while continuing to achieve comparably good results to current methods. Minimizing damage to the remaining trabecular structures as well as to adjacent vertebral disks and vertebrae should be paramount of importance. Options for the treatment of vertebral fractures: Reductions in bone density and pathological changes in bone structure are associated with an elevated risk of fractures, which can lead to decisive functional impairment, pain, and a host of further comorbidities. Vertebral augmentation can be considered as an alternative conservative treatment, in order to achieve immediate and lasting pain relief as well as improvement in functional impairment. To achieve greater safety, instrumentation for transpedicular access and incorporation of radiopacifiers in PMMA for vertebroplasty were developed in mid-eighties. Balloon kyphoplasty was introduced in the end nineties, and results of prospective, randomized clinical studies have confirmed the safety and efficacy; the destruction of the remaining native spongiosa structures during balloon expansion is viewed as a disadvantage of this method. The two step method of cavity creation followed by cement delivery known as kyphoplasty has been further refined and developed by and varied by technology/procedural developments. This includes most the

radiofrequency kyphoplasty (DFINE Inc., San Jose, CA, USA), in which ultrahigh-viscosity cement is delivered at a controlled delivery rate, following producing a bone sparing size and side specific cavity which minimizes loss of spongiosa, allowing for mechanical stability upon interdigitation of cement into that remaining trabecular bone. This combination has been shown to preserve vertebral structures and reduces the risk of leakages. Finally, systems have been available in which cement augmentation of implants to enhance mechanical stability of the implants or the overall fracture is constructed by load sharing [2].

see Pedicle screw augmentation

see Percutaneous vertebral augmentation.

1)
Bettag C, Jann T, Rohde V, Fiss I, Schatlo B, von der Brelie C. Robot-assisted spinal augmentation procedures: is it worth the increased effort? Eur Spine J. 2023 Jun 13. doi: 10.1007/s00586-023-07735-z. Epub ahead of print. PMID: 37310471.
2)
Bornemann R, Koch EM, Wollny M, Pflugmacher R. Treatment options for vertebral fractures an overview of different philosophies and techniques for vertebral augmentation. Eur J Orthop Surg Traumatol. 2013 Jun 16. [Epub ahead of print] PubMed PMID: 23771597.