# Bony fusion

The “fusion” part refers to the additional surgical procedure to stabilize the two adjacent vertebrae which will, theoretically, be compromised after removing the intervertebral disc. In order to provide surgical fusion, it is usual care to place an intervertebral device, like a bone graft or a cage, between the vertebra to replace the disc tissue and to maintain foraminal height. This procedure can be accompanied by anterior plating, which is assumed to add to the stability of the spine. Subsequent “bony fusion” is deemed to follow upon consolidation of the bone between the adjacent vertebrae through and along the intervertebral device. The intervention is regarded to lead to solid arthrodesis and to carry minimal surgical risks [1) 2) 3)].

Anterior cervical discectomy and fusion (ACDF) has proven effective in treating radicular arm pain. Post-operatively, cervical spine stability is temporarily challenged, but data on bony fusion and speed of fusion are ambiguous; optimum evaluation method and criteria are debated.

AIM: To study bony fusion accomplishment and to obtain an overview of methods to evaluate fusion.

METHODS: A literature search was performed in PubMed and Embase. Included studies had to report original data concerning 1- or 2-level ACDF with intervertebral device or bone graft, where bony fusion was assessed using CT scans or X-rays.

RESULTS: A total of 146 articles comprising 10,208 patients were included. Bony fusion was generally defined as “the presence of trabecular bridging” and/or “the absence of motion”. Fusion was accomplished in 90.1% of patients at the final follow-up. No gold standard for assessment could be derived from the results. Addition of plates and/or cages with screws resulted in slightly higher accomplishment of fusion, but differences were not clinically relevant. Eighteen studies correlated clinical outcome with bony fusion, and 3 found a significant correlation between accomplishment and better clinical outcome.

CONCLUSIONS: In approximately 90% of patients, bony fusion is accomplished one year after ACDF. As there is no generally accepted definition of bony fusion, different measuring techniques cannot be compared to a gold standard and it is impossible to determine the most accurate method. Variations in study design hamper conclusions on optimising the rate of bony fusion by choice of material and/or additives. Insufficient attention is paid to correlation between bony fusion and clinical outcome [4)].

---

Failed solid bony fusion, or pseudarthrosis, is a well-known complication of lumbar arthrodesis. Recent advances in radiographic technology, biologics, instrumentation, surgical technique, and understanding of the local biology have all aided in the prevention and treatment of pseudarthrosis.

A systematic literature review was conducted using the MEDLINE and Embase databases in order to search for the current radiographie diagnosis and surgical treatment methods published in the literature (1985 to present). Inclusion criteria included: 1) published in English; 2) level of evidence I-III; 3) diagnosis of degenerative lumbar spine conditions and/or history of lumbar spine fusion surgery; and 4) comparative studies of 2 different surgical techniques or comparative studies of imaging modality versus surgical exploration.

Seven studies met the inclusion criteria for current radiographic imaging used to diagnose lumbar pseudarthrosis.

Plain radiographs and thin-cut CT scans were the most common method for radiographic diagnosis. PET has been shown to be a valid imaging modality for monitoring in vivo active bone formation. Eight studies compared the surgical techniques for managing and preventing failed lumbar fusion. The success rates for the treatment of pseudarthrosis are enhanced with the use of rigid instrumentation.

Spinal fusion rates have improved secondary to advances in biologies, instrumentation, surgical techniques, and understanding of local biology. Treatment of lumbar pseudarthrosis includes a variety of surgical options such as replacing loose instrumentation, use of more potent biologies, and interbody fusion techniques. Prevention and recognition are important tenets in the algorithm for the management of spinal pseudarthrosis [5].

1)
Cloward RB (1958) The anterior approach for removal of ruptured cervical disks. J Neurosurg 15(6):602–617. https://doi. org/10.3171/jns.1958.15.6.0602
2)
Fowler SB, Anthony-Phillips P, Mehta D, Liebman K (2005) Health-related quality of life in patients undergoing anterior cervical discectomy fusion. J Neurosci Nurs J Am Assoc Neurosci Nurses 37(2):97–100
3)
Smith GW, Robinson RA (1958) The treatment of certain cervical-spine disorders by anterior removal of the intervertebral disc and interbody fusion. J Bone Joint Surg Am 40-A(3):607–624
4)
Noordhoek I, Koning MT, Vleggeert-Lankamp CLA. Evaluation of bony fusion after anterior cervical discectomy: a systematic literature review. Eur Spine J. 2018 Nov 17. doi: 10.1007/s00586-018-5820-9. [Epub ahead of print] Review. PubMed PMID: 30448985.
5)
Chun DS, Baker KC, Hsu WK. Lumbar pseudarthrosis: a review of current diagnosis and treatment. Neurosurg Focus. 2015 Oct;39(4):E10. doi: 10.3171/2015.7.FOCUS15292. PubMed PMID: 26424334.