Spinal implant

Spinal implants

see Cervical spinal implants

Types

Dynamic stabilization systems

see interspinous device

Complications

An implant can fatigue and break; and it can fail before the bones fuse.

This is usually an indicator of continued gross spine instability and a second traumatic surgical operation is required. It is therefore a race between the spine fusing and the metal failing.

Most of the failures (90%) occurred within 6 months after surgery, with a small number (10%) occurring in the following 6 months (usually coinciding with some form of trauma), with no reported cases after 1 year postoperatively. This early occurrence of hardware failure, before bony union, and the lack of failures after one year postoperatively strongly support the idea that instrumented fixation cannot be a permanent form of fixation, and bony fusion should be the important target of intervention. Once the bony fusion has matured, the hardware itself could even be safely removed [1)]

Failures

Improving bone-bone union is the corner stone of improving the outcome and preventing implant failure. In general, the iliac crest has been the best source of high-quality graft. Bone chips from the laminae and spinous processes can be added.

The reason why one continues to harvest bone from the crest is its strong potential to lead to a solid fusion. A review of the results in patients demonstrated that the union rate with pedicle-screw-based posterolateral fusion alone, using only the autograft obtained from laminectomy, allografts and/or synthetic bone, was inferior to that using bone chips from the laminae and spinous processes, augmented by strips from iliac crest bone. Moreover, the use of interbody fusion techniques as an alternative strongly adds to successful results. Here, we would like to mention that many studies supported the idea that lumbar interbody fusion techniques have several theoretical and proven advantages over posterior lateral on-lay grafting techniques. In posterior lateral fusion, the barriers to successful arthrodesis are much greater. The graft is not under compression, vascularity is not as good, and the graft-host interface is less reliable [2)].

Implant-associated infections

Implant-associated infections can have severe effects on the longevity of implant devices and they also represent a major cause of implant failures. Treating these infections associated with implants by antibiotics is not always an effective strategy due to poor penetration rates of antibiotics into biofilms. Additionally, emerging antimicrobial resistance poses serious concerns. There is an urge to develop effective antibacterial surfaces that prevent bacterial adhesion and proliferation. A novel class of bacterial therapeutic agents, known as antimicrobial peptides (AMP's), are receiving increasing attention as an unconventional option to treat septic infection, partly due to their capacity to stimulate innate immune responses and for the difficulty of microorganisms to develop resistance towards them. While host- and bacterial- cells compete in determining the ultimate fate of the implant, functionalization of implant surfaces with antimicrobial peptides can shift the balance and prevent implant infections. In the present study, we developed a novel chimeric peptide to functionalize the implant material surface. The chimeric peptide simultaneously presents two functionalities, with one domain binding to a titanium alloy implant surface through a titanium-binding domain while the other domain displays an antimicrobial property. This approach gains strength through control over the bio-material interfaces, a property built upon molecular recognition and self-assembly through a titanium alloy binding domain in the chimeric peptide. The efficiency of chimeric peptide both in-solution and absorbed onto titanium alloy surface was evaluated in vitro against three common human host infectious bacteria, S. mutans, S. epidermidis, and E. coli. In biological interactions such as occurs on implants, it is the surface and the interface that dictate the ultimate outcome. Controlling the implant surface by creating an interface composed chimeric peptides may therefore open up new possibilities to cover the implant site and tailor it to a desirable bioactivity [3)].

Baxi et al., describe a single center's experience in a retrospective cohort of 109 individuals with spinal implant infections, including clinical, microbiological, therapeutic, and outcome data [4)].

3-Dimensional Printed Spinal Implants

3-Dimensional Printed Spinal Implants

[1)] , [2)]
Mohi Eldin MM, Ali AM. Lumbar transpedicular implant failure: a clinical and surgical challenge and its radiological assessment. Asian Spine J. 2014 Jun;8(3):281-97. doi: 10.4184/asj.2014.8.3.281. Epub 2014 Jun 9. PubMed PMID: 24967042; PubMed Central PMCID: PMC4068848.

[3)]
Yucesoy DT, Hnilova M, Boone K, Arnold PM, Snead ML, Tamerler C. Chimeric peptides as implant functionalization agents for titanium alloy implants with antimicrobial properties. JOM (1989). 2015 Apr;67(4):754-766. PubMed PMID: 26041967.

[4)]
Baxi SM, Robinson ML, Grill MF, Schwartz BS, Doernberg SB, Liu C. Clinical Characteristics and Outcomes Among Individuals With Spinal Implant Infections: A Descriptive Study. Open Forum Infect Dis. 2016 Aug 30;3(3):ofw177. PubMed PMID: 27704027; PubMed Central PMCID: PMC5047418.