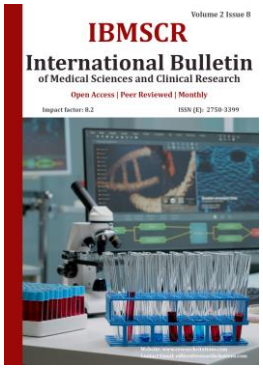

APPLICATION OF MODERN METHODS OF TRANSPEDICULAR FIXATION OF THE SPINE FOR SPINAL COMPRESSION FRACTURES

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Abstract:
The article under discussion reveals transpedicular fixation as one of the most modern methods of surgical treatment of lumbar vertebral fractures, which significantly reduces the trauma of surgical intervention while maintaining all the advantages of open transpedicular fixation. The authors of the article consider that avoiding traumatization of the spinal musculature and bleeding during surgery and reducing the duration of surgical intervention are the main positive aspects of the proposed technique.
Key words: transpedicular fixation of the spine, surgical intervention, vertebrology, compression fracture, transpedicular screws, implants, stability.

Introduction

The most pressing problem in modern vertebrology and orthopedic surgery is spinal compression fracture. Traumatic injuries resulting in disruption of the structural integrity of the thoracolumbar spine can lead to a number of serious health consequences. Only the quickest and most adequate fixation, the unloading of the injured segment, and the formation of a strong muscular corset give a real chance for full recovery.

In cases of spinal shock and other neurological manifestations of spinal compression fracture, stabilizing surgery is performed to remove compression of spinal structures, prevent ischemic changes and restore the spinal axis. In addition to minimally invasive kyphoplasty, high-tech transpedicular fixation, placement of cages (intervertebral disc replacements), autografting, etc. may be used.

The main part

Transpedicular fixation or TPF is an operation in which vertebrae are fixed and stabilized with special implants (transpedicular screws). Each vertebra has a screw insertion point, which was established in 1985 by Roy Camille, the point where the transverse process meets the superior articular process. Using special tools, screws are screwed into this point, determining the anatomically correct location of the spine, thereby curing the disease. The first attempts to insert implants were made in 1960-1970 years and since then has been the "gold standard" in the treatment of fractures and various diseases of the spine [2].

The TPF technology has been especially actively developed over the last 20 years, during which time not only the peculiarities of installation of metal structures into the spine have been thoroughly studied, but also the list of indications and contraindications for its use has been accurately determined.

TPF is performed under X-ray monitoring, which allows the surgeon to accurately control each movement and avoid damage to nearby anatomical structures. More often an EOP or CT scan is used for this purpose. When inserting the screws it is very important to observe the

following points: no space between the bone and the screw, no trauma to the nerve and vascular structures or adjacent articular joints. Implants are inserted according to the dimensional ruler of each vertebra and screw, bicortically without touching the closure plates [4].

In order to get the best result from the surgery, an interbody cage is often used, which must meet the following requirements:

- ensure stability of the vertebral bodies;
- ensure the normal height of the intervertebral discs, thus avoiding nerve compression;
- to be made with a special space through which bone cement, artificial bone substitutes or drugs that increase bone growth can be injected;
- correct and fix the lateral (sagittal) and anterior (frontal) balance of the spine;
- to hold the load that falls on the spinal axis.

Modern requirements for transpedicular fixators

- absolute biological inertness - the implants must not oxidize in the body environment, they must acclimatize well, and they must not cause rejection reactions, which allows for lifelong implantation and no removal surgery is planned.
- MRI Compatibility - implants must not be ferromagnetic, so as not to be heated by magnetic fields. Furthermore, good implants have minimal MRI and CT coherence in adjacent soft tissue areas - this allows for comparison of preoperative and postoperative images to get reliable information.
- fatigue resistance - most titanium alloys are very hard but also rather brittle, they cannot withstand shock loads, quickly accumulate fatigue stress and break.
- qualitative titanium fixators are made of special alloys with high plasticity and manufacturers state that they do not break during fatigue tests, usually these tests require 10 million load cycles, which is how many steps a person can walk in 60 years, therefore modern manufacturers give lifetime warranty on titanium fixators.
- ease of installation is a very subjective characteristic, reflecting the ability to mount an extended system adapted to the curves of the spine, and if necessary - to correct the deformity of the spine in 3 planes, modern designs have several stages of fixation, when mounting the construction. Staged fixation allows to perform such maneuvers as derotation, reclination, contraction, reduction independently - it allows the most complete and safe restoration of the support function of the spine.
- percutaneous installation - most modern spinal fixation systems have modifications that allow installation of fixators without incisions, through punctures, and to mount the structure under the skin without making an incision
- cemented systems are another option that makes it possible to introduce bone cement into the vertebral bodies through the installed fixators and thus strengthen the position of the framework; such constructions are used in case of osteoporosis when the risk of migration of the fixators is high; the first surgeries with cemented screws in the world were performed by D. Dzukaev (invention patent obtained), the results of surgeries were presented at the international congress in Davos in 2004. Currently, all leading manufacturers produce cemented screws for osteoporosis surgeries.

Indications

Such surgical intervention is widely used to treat a huge number of diseases and injuries of the spine in any department. It is mostly performed in severe situations where the possibilities of other methods have been exhausted or when no alternative patient care options are available. Indications for TPF are: unstable fractures; recurrence of herniated disc degenerative diseases, including osteochondrosis; spinal deformities, especially scoliosis of degree 3 and 4; spondylolisthesis; spinal stenosis; increased mobility of segments of the spinal column; pseudarthrosis [1].

Practice shows that the TPF technique has significant advantages over the others when it comes to treating spinal fractures. It provides closure of only a short segment, movement to an anatomically correct position, and stable fixation by mounting only one structure. This guarantees the possibility of early mobilization of the patient, while requiring no external immobilization.

Spinal instability is considered to be one of the most common diseases and the main method of treatment is transpedicular fixation of the moving segment, decompressive laminectomy, discectomy with installation of a cage between the vertebral bodies, which fixes the segment in 360° (gold standard). In such situations, the method provides reliable spondylodesis in 80-95% of patients. TPF is one of the most commonly used methods for surgical treatment of diseases and injuries due to the fact that modern surgeons try to achieve 360° spondylodesis [5].

This can be achieved by combining TPF with interbody fusion, which ensures a high rate of bone fusion and the absence of residual slight motion in the anterior parts of the operated segment. Therefore, patients are guaranteed to be free of pain syndrome if the surgery is completed successfully and the recovery is correct.

Transpedicular fixation is characterized by:

- low traumatism;
- the presence of rapid bone fusion and the emergence of spondylosis. This factor contributes to reliable fixation of the spine and guarantees the absence of future fractures;
- low risk of damage to nerves, blood vessels, and articular joints if performed correctly;
- short periods of hospitalization and subsequent incapacity for work;
- ease of rehabilitation;
- possibility of early activation.

When properly performed, the technique provides pronounced positive treatment results in the vast majority of situations. With its help it is possible to restore partial or even absolute functional ability of the spine after serious injuries, which resulted in paralysis. It also allows to eliminate the pain syndrome accompanying diseases, including scoliosis.

Transpedicular fixation is a complex surgical procedure, requiring the surgeon's precision. The slightest mistake can provoke a succession of complications, including: inflammation in the area where the screw is installed, nerve and vessel damage, which can lead to loss of sensation of those parts of the body for which the root was responsible, and breakage of the implant.

Contraindications

TPF is not recommended for:

- grade 4 obesity;
- severe osteoporosis with severe bone loss;

- pregnancy at any stage of pregnancy;
- individual hypersensitivity to cage and screw materials.

TPF cannot always be performed for injuries to the upper segments of the thoracic spine because of their small size.

Rehabilitation

Until full recovery, patients should refrain from lifting heavy objects and increased physical activity. Light housework and walking are allowed. Subsequently, with the permission of the doctor, sessions of therapeutic physical training are connected. A specially selected complex of exercises will help to consolidate the results achieved and speed up the recovery of the body.

Conclusions

Thus, transpedicular fixation of the spine is one of the most modern methods of surgical treatment of lumbar vertebral compression fractures, allowing one to significantly reduce the trauma of surgical intervention while maintaining all the advantages of open transpedicular fixation. Avoiding traumatization of the spinal musculature and bleeding during surgery and reducing the duration of surgical intervention are the main positive aspects of the proposed technique.

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