Surgical options in the treatment of the spinal disorders in ankylosing spondylitis

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ABSTRACT

Serious complications or unsatisfactory results in the past often have made patients as well as doctors hesitant to decide for surgery in ankylosing spondylitis. Though the techniques of correction for fixed flexion deformity still are demanding, decisive progress has been made toward less complications, less operative trauma and better quality of life after surgery.

The present work represents a short review of the evolution of surgical techniques in treatment of spinal disorders encountered in ankylosing spondylitis. Emphasis is given to the benefits of improved instrumentation systems, intraoperative navigation, spinal cord monitoring and endoscopic surgery done in the prone position in completing the circumferential osteotomy of the thoracolumbar and lumbar spine in a safe and successful way.

Fifty patients with deformities in the lumbar and thoracolumbar spine and 34 with deformities in the cervical spine were treated by instrumented corrective osteotomies. Excellent correction of the disturbed sagittal profile with restoration of a horizontal axis of vision was achieved in all of them. Neurological deterioration occurred in seven patients and was completely reversible in five of them.

Introduction

The role of surgery in the treatment of spinal disorders in ankylosing spondylitis has gained a more outstanding position. This can be attributed to several factors:

- Better understanding of the disturbed biomechanics of the deformity.
- Medical advances in the field of anaesthesia and intensive care unit with the possibility of autotransfusion.
- Spinal cord monitoring.
- Development of less invasive techniques utilising navigation systems and endoscopical assistance.
- Improvement of the imaging techniques.
- Availability of more reliable instrumentation systems.
- General improvement of the surgical skills of spinal surgeons.

The indications for surgical treatment in ankylosing spondylitis are the following:

- Unstable injuries
- Andersson's lesions with or without neurological deficit
- Painful spinal deformity.
- Functionally and or cosmetically unacceptable deformities

Correction of lumbar and thoracolumbar deformities - Background

Credit should be given to Smith Peterson *et al.* (7) who published their experience with a posterior osteotomy technique for the surgical correction of ankylosing spondylitis. The technique is effective when the anterior syndesmophytes are disrupted through extension of the spine. It was however observed that anterior bony bridges are a considerable obstacle against the correction. This was the cause for the emergence of the two stage procedure. Law (4) recognised the advantage of internal fixation in maintaining the achieved correction. It was, however, Zielke (3) who emphasised the role of polysegmental posterior osteotomies and transpedicular fixation. The main advantage of this technique is the restoration of a more harmonious sagittal profile because the correction is done over several segments. Scudese and Calabro (6) introduced the egg-shell technique and Thomasen (8) popularised the technique. From the end of the eighties no remarkable changes have been introduced except in the field of the instrumentation systems and the improvement of the anaesthetic care and the intensive care units which allowed the two stage procedure to be

done in one sitting. The problem remained, that the operative correction required major trauma to safely approach the patient's spine.

In 1994, Boehm (1) introduced a new minimally invasive technique approach for osteotomy of the anterior spine, that in 1996 could be optimised to performing the anterior and posterior stages in one single, the prone position (2). The anterior osteotomy is done through a key-hole incision with the aid of the endoscope. The technique has the following advantages:

- It avoids repositioning of the patient and re-draping for correction of the deformity. In this way it is time saving and more safe than a technique which needs intraoperative change of the patient‘s position.
- The anterior procedure is done in a minimally invasive way using key-hole incision. This decreases the incisional morbidity and at the same time avoids potential problems associated with conventonal thoracotomies and thoraco-lumbotomies. In fact, any surgical approach which avoids a phrenotomy or open thoracotomy is desired in those patients.
- The only way which ensures that circumferential release is adequate is a technique which offers the surgeon the possibility of having both anterior and posterior accesses to the target simultaneously. Actually, this is the main advantage in the strategy of correction of kyphosis.
- The technique offers a reasonable solution for kyphosis of the bamboo spine where the multiple posterior osteotomy technique of Zielke frequently fails.
- Should – as often in longstanding Anderson’s lesions – the cord needs anterior decompression, this can be performed safely and effectively under endoscopic vision and control.

Minimally invasive technique of corrective osteotomy in the lumbar and thoracolumbar spine

The procedure is done in the prone position and is carried out in steps.

Step 1: Posterior osteotomies and implantation of transpedicular fixation screws. Posterior exposure of the spine is done in the normal way described by Stagnara. Transpedicular screws are inserted and fluoroscopy is then done to assure optimal placement and length of the screws. Multiple V-shaped osteotomies are done at the most commonly involved segments in the kyphosis, this is commonly the thoracolumbar junction. The part to be removed is dictated by the amount of correction needed. Care should be taken in fashioning the osteotomy so that it can be closed safely without compressing any neural structures.

Step 2: Anterior endoscopically assisted osteotomy and fusion. A keyhole incision (3 cm) placed opposite the apex of the kyphosis at the level of the posterior axiallary line. A second portal (1.5 cm) is used for insertion of the endoscope. A special set of instruments is used for keeping an adequate and safe access to the target. The prevertebral pleura is split at the target. In the spondylarthritic ossification type, correction of the deformity is usually achieved through the posterior osteotomies and the role of the minimal invasive anterior procedure is just to debride the end plates and to restore the anterior spinal column for rapid bony consolidation. This is particularly needed in those cases with Anderson’s lesions where the correction of the deformity accentuates the anterior gap. In the bamboo-spine, anterior osteotomy is necessary to achieve correction of the spine. After meticulous division of all bony elements anterior to the spinal cord the trunk is gradually extended to correct the deformity (Fig 1). The created gap(s) are then filled with bone graft or cage filled with cancellous bone. In cases of severe instability additional fixation devices from anterior might be needed. They can be applied in the same minimal invasive technique. For locations caudal to L2, the anterior spine is similarly treated via a retroperitoneal mini- approach.

Step 3: Completion of the posterior spondylodesis: the rods are inserted and tightened at the heads of the screws. Posterior spondylodesis augmented with bone chips is then done and the wound is closed in layers. Intraoperative SEP monitoring and wake-up test are routine measures to assure safety of the procedure.

Correction of cervicothoracic kyphosis - background

The cervicothoracic spine is a common site for the development of kyphosis. Plain radiography can poorly image this area and MRI is very helpful in illustrating this region. The kyphotic deformity is commonly fixed. Infrequently, a mobile kyphotic deformity can be encountered particularly in those who sustained an occult fracture. The weight of the head with the neck flexed results in a leverage effect at the base of the neck, this is why the cervicothoracic junction is more susceptible to these compression fractures and for the development of instability and Anderson’s lesions.

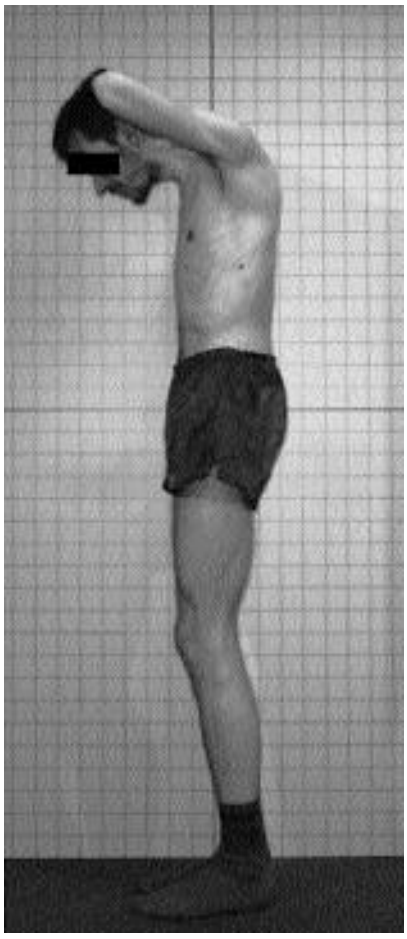
Many modifications have been done since the introduction of Urist’s osteotomy (9). The osteotomy can be done under local anaesthesia and a halo vest can be applied for gradual correction of the deformity. Some authors prefer to apply direct internal fixation. In our experience osteotomy should be performed wherever bony bridges hinder a smooth and non forceful correction of kyphosis. In the cervicothoracic junction it might be necessary posteriorly alone or in combination with previous anterior release.

Mobile kyphosis: technique of correction

The surgery is done in the prone position under general anaesthesia. SEP is used for monitoring the cord function during the procedure. The spine is exposed from the midcervical region to the 3-4 thoracic vertebra. Screw-rod system is used for fixation of the spine in which pedicle screws are inserted in vertebrae Th2-4. Lateral mass screws are inserted as described by Magerl in C4-C6. Fluoroscopy is then done to verify the position and length of the screws. The posterior elements of C7 are removed together with part of C6 and T1. The amount to be removed is adjusted roughly according to the amount of correction that is needed. Complete pediculotomy of C7 is done

(a)

(b)



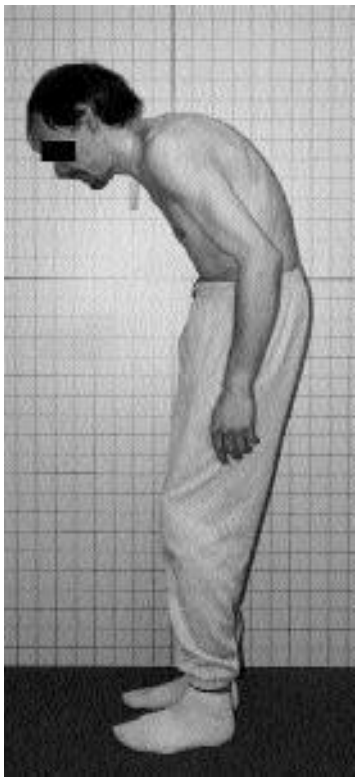
(c)

(d)

Fig. 1. Minimally invasive technique of corrective osteotomy in the lumbar and thoracolumbar spine.

(a)

(b)



(c)

(d)

Fig. 2. Fixed cervico-thoracic deformity. Technique of correction.

to avoid secondary foraminal stenosis following the correction. The neck is then extended until the needed correction is obtained. The rods are then inserted and kept in place with the nuts. Wake up test is then done to assure that the patient is still neurologically stable. The removed bone is then used at the osteotomy site to augment the fusion. If the anterior gap created through the correction is wide and would require a long time for spontaneous bridging, we recommend to bridge it with bone graft or a cage filled with cancellous bone. This requires a second approach from the front, but usually can be performed in the same anaesthesia. Due to a much more rapid bony consolidation this additional surgery usually pays very well by reducing the risk of loss of correction, need for postoperative external support and speeding up markedly the postoperative course.

Fixed cervico-thoracic deformity: technique of correction

Here, it is preferred to start with anterior release in the form of osteotomy done at the C7-T1 disc. The patient is then turned into the prone position and the technique is completed as correction of mobile kyphosis (Fig. 2).

In those presenting with head on chest deformity there is no possibility to do the anterior release through an anterior approach. The anterior osteotomy is then done through a posterior approach with the aid of CT- or interventional MRI-navigation to assure safety of the important neighbouring structures.

Correction of atlantoaxial disclocation - background

Atlantoaxial subluxations and disclocation – though infrequently encountered – present a significant problem in ankylosing spondylitis. The mechanical overload imposed upon the relatively spared upper cervical segments in the otherwise ankylosed spine enhances the development of this complication. Significant trauma is frequently denied by those patients. Those who are lucky enough not to develop acute neurological manifestations are still at a high risk for the development of late myelopathy.

Atlanto-axial dislocation, technique of reduction

Surgical reduction and fusion before the onset of neurological problems gives excellent results as regards correction of deformity and pain. Even in neglected cases, that already have developed myelopathy surgery should be regarded. Reducible C1-C2 subluxations and disclocations can be stabilized using the transarticular fixation method adopted by Magerl (5). Irreducible fixed C1-C2 dislocation with spinal canal stenosis presents a real surgical challenge. It is wise in such a situation to combine a transoral release with a posterior release, reduction and C1-C2 transarticular fixation. Intraoperative spinal monitoring is an essential measure in this respect.

Results

Eighty-four patients in the period between 1 January 94 and 31 December 1999 underwent osteotomies for correction of the deformity in ankylosing spondylitis; 76 patients were males and 8 were females, reflecting the male gender predilection. Operations in the cervical spine were done in 34 patients and in the thoracic and lumbar spine in the remaining 50 patients. The youngest patient at the time of operation was 26 years and the oldest one 78 years (mean: 49.4 years). Correction of the deformity succeeded in restoring a horizontal axis of vision in the 84 cases. Dramatic relief of pain was observed in those with painful Anderson's lesions.

Complications

No mortalities were encountered in this series. Unfortunately, one patient developed complete paraplegia one day after the operation. The relatively late onset of this drastic complication together with absence of possible mechanical causes suggested cord ischaemia as the causative factor. Irreversible unilateral paresis of the C7 and C8 roots were encountered in one patient after cervicothoracic osteotomy of severe long standing kyphosis. Temporary paresis of the C5 root was seen in one patient. Transient disturbance of the brachial plexus due to positioning was encountered in four instances. All of them recovered in the first 3 months after the operation. Wound infection occurred in two patients and healed after surgical debridement and re-closure of the wound. Pseudarthrosis was encountered in only two patients.

Conclusion

Most of the traditionally performed old procedures for osteotomies are considered formidable. Introduction of minimal invasive techniques and availability of better implants, however, have allowed a dramatic improvement in the results of surgical treatment. Spinal corrective osteotomy still is a major surgery, but in the hands of the experienced surgeon it yields very satisfactory improvement of the patient's quality of life.

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