The surgical treatment and related management for post-tubercular kyphotic deformity of the cervical spine or the cervico-thoracic spine

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Abstract

Purpose The outcomes of surgical treatment and related complications of post-tubercular kyphotic (PTK) deformity of the cervical spine or the cervico-thoracic spine were evaluated.

Methods From January 2005 to October 2010, 12 cases with PTK (7 males, 5 females) with an average age of 30 years (range 21–43 years) formed the study group. There were ten patients with cervical deformities and two with cervico-thoracic kyphosis. Neurological function of all the patients was evaluated by the Japanese Orthopaedic Association (JOA) score and visual analogue scale (VAS) score. Two patients with severe cervico-thoracic deformity received modified skeleton traction pre-operatively. Ten patients underwent anterior debridement and reconstruction, using iliac crest or cages with autografts, while two patients with cervico-thoracic kyphosis received posterior instrumentation and fusion.

Results The mean pre-operative focal kyphotic angle was 42.58° (range 30–67°), reducing to -8° (range -15–11°) postoperatively (at the last follow-up visit). The average operating time was 117.50 min (80–200 min) with an average blood loss of 110 ml (range 50–300 ml). Neurological assessment of all the patients, using the Japanese Orthopaedic Association (JOA) score and visual analogue scale (VAS) score, was improved significantly after surgery. All patients had solid fusion and no major complication was observed in the follow-up.

Conclusion One-stage anterior debridement, instrumentation and fusion for cervical spinal TB and single posterior

instrumentation for cervico-thoracic spinal TB followed by chemotherapy is practical to correct PTK. The procedure has the advantage of lower blood loss, effective kyphosis correction and minimal complications. To patients with severe deformity, skeletal traction seemed indispensable.

Introduction

In many parts of the world, especially in developing countries, tuberculosis (TB) has experienced a broad resurgence in the past two decades. Spinal TB is mostly involved within the musculoskeletal system, and usually leads to serious sequelae if not treated adequately [1]. Unlike commonly seen in upper lumbar and lower thoracic lesions, the surgical management of TB in cervical and cervico-thoracic spine differs and is rarely seen in literature. In the cervical or upper thoracic spine, the spinal cord is prone to be compressed [2]. Panvertebral disease can cause pathological subluxation or dislocation of the spine and the resultant instability can damage the cord [3]. Pedicle involvement is also part of the disease process and usually associated with relatively severe vertebral body and disc destruction, wide prevertebral abscess and severe kyphosis [4]. With improvements in tomography and diagnostics, new operating-theatre facilities and the use of modern spinal instrumentation, healing may be achieved with minimal or no loss of correction of deformity [5].

In our study, the clinical and radiographic results of 12 patients with cervical and cervico-thoracic TB kyphosis were evaluated. We propose that a one-stage procedure, with an anterior approach for cervical kyphosis and a posterior approach for cervico-thoracic kyphosis, supplemented with chemotherapy and nutritional support can achieve a satisfactory outcome.

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Materials and methods

Patient data

From January 2005 to October 2010, 12 patients with post-tubercular kyphotic deformity formed the study group (Table 1). There were seven males and five females with an average age of 30 years (range 21–43 years). All patients had a history of childhood spinal tuberculosis and were treated by ambulatory chemotherapy. The indications for surgery were radiological demonstration of a cervical or cervico-thoracic vertebral lesion, presence of acid-fast bacilli detected on direct examination, bone destruction with progressive kyphotic deformity, poor response to medical treatment, deterioration in neurological status and mechanical instability [6].

The number of vertebrae involved in the fusion mass ranged from three to ten.

On the lateral plain X-ray films as suggested by Rajasekaran [7], kyphosis was measured before and after the operation and also at the final follow-up. According to the criteria described by the Lee et al., postoperative radiographs were examined to assess the level of bony fusion [8]. Magnetic resonance imaging (MRI) was performed to evaluate the site of compression and status of the cord. The Japanese Orthopaedic Association (JOA) scores were 8 in seven patients, 9 in three patients and 6 in two. The mean visual analogue scale (VAS) score was 4.5 (range 3–7).

Surgical technique

Before the operation day, all patients were treated with anti-tuberculous therapy until the erythrocyte sedimentation rate

(ESR) decreased to 20 mm/h. The surgical procedure for the ten cervical kyphosis patients comprised of anterior debridement, corpectomy and fixation with iliac crest grafts or titanium cage, and anterior cervical plate. This was the standard practice for the treatment of this series of cases. In these patients, a corpectomy and discectomy were performed, and all necrotic and devitalized tissues were removed as far as possible until normal bleeding bone was reached. The spinal cord was then decompressed carefully. With the destruction of a focal vertebrae, one healthy vertebra above and one below were incorporated for spinal instrumentation. Bone grafts, taken from iliac crests, were used to fill in the defect after the debridement of the diseased vertebrae, or inserted into the cage then placed into the resected vertebra body. Before the bone graft was wedged into the defect, a Caspar distractor was used to correct the kyphotic deformity. Intra-operative anteroposterior and lateral fluoroscopic images were taken to confirm the correction of deformities and graft position.

Two patients with severe deformity, with a kyphotic magnitude over 60°, underwent skeleton traction using a modified halo-vest which we designed for about one week before surgery, followed by posterior fixation with lateral mass screws in the lower cervical spine and with pedicle screw in C7 and the thoracic spine.

Postoperative care

The patients were told to sit up in bed with cervical collar protection for one week after surgery and allowed out of bed with continuous cervical collar stabilization for a further three to four weeks. In addition to the antituberculous

Table 1 Patient, operative and postoperative data

Case	Age	Sex	Onset to operation (months)	Pre-op in-patient stay (days)	Levels involved	Fixation	Operative time (min)	Blood loss (mL)	Follow-up time (months)	Postop hospital stay (days)
1	27	M	3	2	C4	3	80	50	24	6
2	40	F	3	2	C4-C5	4	120	120	22	7
3	35	M	2	4	C4-C5	4	160	50	12	5
4	21	M	5	2	C3-C4	4	90	90	18	8
5	30	M	6	2	C4	3	80	150	24	6
6	25	F	4	3	C4-C6	5	80	50	50	9
7	37	M	6	2	C3-C4	4	130	110	12	7
8	34	F	7	2	C6-C7	4	90	100	48	6
9	22	M	11	3	C5-C6	4	120	100	24	8
10	22	M	3	2	C4-C5	4	80	50	36	8
11	24	F	6	7	C6-T2	8	180	150	20	10
12	43	F	5	8	C5-T3	10	200	300	12	12
Mean	30		5.08	3.25		4.75	117.50	110	25.17	7.67

M male, F female

chemotherapy, intravenous antibiotic drugs were administered to all patients after surgery for five to eight days until the patient was discharged from our hospital. All patients were asked to take nutritional support after surgery.

Results

Surgical procedure

All procedures were performed by one senior doctor (Dr. Wen Yuan). Average operating time was 117.50 min (range 80–200 min) with blood loss of 110 ml (range 50–300). The number of vertebrae affected in individual patients ranged from one to four, and a mean of 4.75 levels were fused (range 3–10).

Postoperative data and complications

The in-hospital stay before surgery was a mean of 3.25 days (range 2–8), and an average of 7.67 days (range 5–12) was spent in the hospital after surgery. The mean follow-up time was 25.17 months (range 12–50 months). The focal kyphosis at the infected level before surgery averaged 42.58° (range 30–67°), and was corrected to a mean postoperative angle of −8° (range −15–11°). The pre-operative motor deficits improved significantly after surgery. No patient developed a pseudarthrosis or proximal junction kyphosis. All patients received an appropriate course of antibiotics as recommended by the infectious disease consultants after the surgery. All patients experienced complete healing of their spinal infections.

Outcome analysis and neurologic improvement

The postoperative JOA score was 12 in eight patients, 11 in three patients and 9 in one, improving from pre-operative 7.9 to 11.5 points on average. The pain level decreased gradually throughout the follow-up period in all 12 patients. The mean pre-operative VAS was 4.5 (range 3–7). This decreased significantly to 1.3 (range 0–3) at the last follow-up (Table 2).

The wounds were healed without chronic infection or sinus formation. Fusion was evaluated by flexion-extension radiographs. All patients achieved fusion at the last follow-up (Figs. 1 and 2). There was no recurrence of disease in any of the patients at the last follow-up.

Discussion

Studied extensively both clinically and radiographically, spinal tuberculosis is the most common cause of kyphotic deformity in many parts of the world [9]. Advances in the radiologic technology enable details of the disease process to be studied. Spinal tuberculosis involves and destroys the anterior column in 90% of patients, and kyphotic deformity often results before natural healing occurs [9]. Patients with deformity caused by spinal TB and severe neurological deficits should be treated with surgical decompression and correction [10]. Pedicle involvement can be detected early from MRI and carefully documented as it may influence the treatment strategy.

Rajasekaran et al. [11] treated 81 patients with tuberculous of the spine with anterior debridement and arthrodesis,

Table 2 Outcome and radiographic data

Case	VAS			JOA			Kyphotic angle				
	Pre-op	Postop	Last follow-up	Pre-op	Postop	Last follow-up	Pre-op	Postop	Last follow-up	Correction	Rate (%)
1	4	2	3	8	11	12	30	−15	−12	42	140.00
2	3	2	1	8	11	12	37	−10	−10	47	127.03
3	3	2	0	6	11	11	41	−11	−11	52	126.83
4	4	3	2	8	9	12	35	−13	−15	50	142.86
5	3	1	2	8	10	11	30	−10	−10	40	133.33
6	4	1	0	9	11	11	37	−13	−11	48	129.73
7	3	1	1	9	11	12	32	−10	−10	42	131.25
8	6	3	0	8	12	12	35	−12	−13	48	137.14
9	5	2	0	8	11	12	40	−12	−15	55	137.50
10	5	3	2	9	12	12	41	−10	−12	53	129.27
11	7	3	2	8	11	12	63	9	10	53	84.13
12	7	3	2	6	10	9	90	11	12	78	86.67
Mean	4.5	2.17	1.25	7.92	10.83	11.5	42.58	−8	−8.08	50.67	118.98

Fig. 1 **a, b** A 22-year-old male patient with cervical kyphosis caused by tuberculosis underwent anterior decompression and correction. A corpectomy was performed followed by autograft transplantation and cervical plate fixation. The lateral view of X-ray film at last follow-up showed satisfactory correction of the deformity and solid fusion of operative segments. **c, d** The patient was a middle-aged female,

demonstrating C4/5 collapse and cervical kyphotic deformity. After removal of diseased vertebra and completed debridement, a titanium mesh associated autograft was placed in site followed by anterior plate stabilization. The last follow-up witnessed solid fusion, and good sagittal alignment of cervical spine was restored

and demonstrated poor results for thoracic lesions especially those with marked pre-operative kyphosis.

In all the patients of our study, neurological recovery after surgery was remarkable. Neurological improvement started from the postoperative day in 75% of cases. The introduction of antibiotics allowed bacterial control of the disease and healing [1]. A postoperative regimen of anti-tuberculous drugs can effectively enter pathologic sites and recover the bone lesions [12]. Current antitubercular drugs reach pus, granulation tissue, caseous tissue, bone and cavities in concentrations well above the minimum inhibitory concentration and the lesion can be sterilized [13].

In a long-term follow-up study reported by Avusoglu [6], antituberculosis chemotherapy was instituted on the day of surgery. All patients were treated with an antituberculous chemotherapy regimen in a study reported by Huang et al. [14].

Serious complications with posterior vertebral column resection in thoracic and lumbar spinal TB were reported by Suk et al., including six serious hematomas, five implant failures that needed revision, and two complete cord injuries. The two patients who underwent posterior surgery had no major neurological complications due to preservation of anterior column. Our patients completed an appropriate

Fig. 2 A 43-year-old female had experienced progressive cervico-thoracic kyphosis for 5 years before surgery. MRI (**a**) and CT scan (**b**) found severe kyphotic deformity at the junction area of cervico-thoracic spine. The symptoms of the patient including severe pain and moderate neurologic deficits at four extremities (JOA 6). Posterior

decompression and lateral mass screw and pedicle screw fixation was performed to achieve the satisfied correction of the deformity. The patient achieved realignment of sagittal plane of cervical spine as well as significant pain relief and improvement of neurologic function (JOA 10)

course of antibiotics, and all of the patients experienced complete healing of their spinal infections. There were no major complications like spinal cord or root lesions.

In ten patients with tuberculous spondylitis treated by a two-stage operation (posterior and anterior) using posterior spinal instrumentation reported by Hirakawa et al., the average correction angle of kyphosis was relatively small [15]. In a study reported by Louw [16], through a combined anterior/posterior approach, thoracic or thoraco-lumbar spinal tuberculosis kyphotic deformity was corrected by 50%; however, kyphotic angles remained at an average of 30° after surgery. Unlike thoracic or thoraco-lumbar kyphosis correction, the correction of cervical and cervico-thoracic kyphosis is much better, by more than 100%. In our study, the mean kyphotic angles of ten patients with cervical kyphosis improved from 35.8° to -11.6° postoperatively, and at final follow-up to -11.9°; and the other two patients with cervico-thoracic kyphosis improved from 76.5° to 10° postoperatively, and at final follow-up to 11°. Solid fusion was achieved in all 12 cases. Neurological conditions in all patients were improved significantly after surgery.

Thoracic transdiscal osteotomy is a safe surgical treatment of thoracic discitis with vertebral body involvement and collapse [17], which can resect the infected disc material, achieve neurologic decompression, stabilize the spine, and correct the kyphotic deformity through a single approach in the thoracic spine. In a study of 39 adults with tuberculosis of the cervical spine described by Moon et al. [18], intercorporeal bony fusion has been attributed to good bony contact of the two involved vertebral bodies adjacent to the destruction of the disc and the end-plate cartilage at the involved level. For patients with cervical kyphosis, the anterior procedure is easy to perform and exposes the diseased segments. Removal of involved vertebra, decompression of spinal cord and correction of deformities is a safe and effective way of surgical treatment. For patients with cervico-thoracic kyphotic deformities, the single posterior procedure with decompression, correction, instrumentation and fusion is practical with a satisfactory clinical outcome.

Our experience in treating post-tubercular kyphosis using one-stage anterior debridement, instrumentation and fusion for cervical spinal TB and single posterior instrumentation for cervico-thoracic spinal TB followed by chemotherapy is feasible and safe to correct PTK. The procedure has the advantage of lower blood loss, effective kyphosis correction and minimal complications. For patients with severe deformity, skeletal traction pre-operatively seems indispensable.

Conclusion

Anterior spinal decompression and grafting with instrumentation in the treatment of cervical tuberculosis is safe and

efficient, with effective kyphosis correction and minimal complications.

The advantages of anterior debridement and arthrodesis of spine include direct access to and excision of the focus of disease, with the ability to decompress the cord, rapid healing by osseous union, and a decreased tendency for progressive collapse of the kyphosis. For severe post-tubercular kyphosis of the cervico-thoracic junction area, pre-operative skeleton traction followed by instrumentation and correction is a safe process and may achieve satisfied radiographic and clinical outcome.

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