Sp33: How much of pre-treatment local kyphosis can be accepted and what level of kyphosis is an indication for spinal fixation and reconstruction?

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Response/ Recommendations:

1. Based on available data, kyphosis $>30^0$ may be considered as an indication for spinal fixation and reconstruction in spine in ***paediatric*** population.

Strength of recommendation: Strong

Delegate Vote:

2. Based on available data, kyphosis $>60^0$ may be considered as an indication for spinal fixation and reconstruction in spine in ***adult*** population.

Strength of recommendation: Strong

Delegate Vote:

Rationale:

It is common knowledge that kyphosis beyond a certain degree can cause pain and/ or be a cause of neurological deterioration. It is also common knowledge that angular kyphosis following spinal tuberculosis behaves different from rounded kyphosis seen in entities such as Scheueurmann's kyphosis. However, despite this qualitative knowledge, there is unfortunately, a dearth of unequivocal objective clinical data on the extent of kyphosis that will be considered pathological.

Zong et al studied global sagittal spinal profile of thirteen adult patients with angular kyphosis secondary to spinal tuberculosis[1]. There were eleven patients with thoracolumbar involvement, one with lumbar [L2-3] and one with thoracic [T6-7] involvement. They noted a compensatory increase in lumbar lordosis and decrease in thoracic kyphosis secondary to this angular kyphosis in these patients. However, the authors could not elucidate a critical cut-off value for the kyphosis angle beyond which these compensatory changes could lead to serious consequences.

Similarly, Smith IE et al tried to study pulmonary compromise in patients with severe thoracic kyphosis secondary to spinal tuberculosis[2]. In their study involving seven patients, minimum kyphosis was 95^0.

Zhao J et al tried to study predictive factors for late-onset neurological deficits in patients with post-tubercular thoracic kyphosis[3]. However, they selected only those adult patients who had kyphosis $>80^0$ in this analysis. On a similar note, Wong YW et al studied long term consequences of severe post-tubercular thoracolumbar angular kyphosis; one of the inclusion criterion for the study being $>65^0$ kyphosis[4].

Rajasekaran published a landmark article to identify spine-at-risk signs in paediatric spinal tuberculosis[5]. The same author also published a formula to predict angle of kyphosis at the end of nonoperative treatment based on the extent of vertebral loss at the start of treatment[6].

Ahuja K et al published tuberculosis spine instability score in which they considered adjusted kyphosis as one of the many factors considered for identifying instability[7]. Accordingly, they assigned three points for kyphosis $>60^0$; two points for 30-60^0 kyphosis and one point for 10-

30^0 kyphosis. Adjustment of kyphosis was done by adding 5^0 lordosis for every segment in subaxial spine and in lumbar spine, except for L4-5 and L5-S1 where it was 15^0 lordosis.

The thirteenth report of MRC trials, involving 350 patients with thoracic and lumbar tuberculosis treated by nonoperative method in Korea, showed an increase in kyphosis in the nonoperative group of spinal tuberculosis patients of 21^0 in the first five years and 25^0 in the first fifteen years following the disease[8]. However, out of these 350 patients, only 5 patients were in the age group of 15-19 years at the time of entry into the trial while all the others were younger than this age group.

Another long-term study of patients with thoracic and lumbar spinal tuberculosis over ten years was carried out by Parthasarathy R et al[9]. Nonoperative treatment was carried out in seventy-three patients aged upto 14 years, seventy-seven patients aged 15 to 34 years and fifty patients aged 35 or more years. Of these, 121 patients had kyphosis $<30^0$ and seventy-nine patients had kyphosis between 31^0-60^0. On a general note, they noted an increase of 10-11^0 in the first eighteen months of the disease following which the increase was only 3-6^0 over the remaining part of the ten-year follow-up. On analyzing this data further, they noted only 11^0 mean increase in kyphosis over ten years if the presentation kyphosis was $<30^0$ for patients in all age groups. For patients more than fifteen years of age too, there was a similar increase of mean 10^0 over ten years for those with kyphosis $>30^0$ at the time of presentation. However, this increase in kyphosis shot up to mean of 30^0 in patients less than fifteen years of age with kyphosis $>30^0$ at the time of presentation.

More recent research carried out by Nene A and Bhojraj S has thrown more light on this topic[10]. They conducted a retrospective study on seventy adult patients with kyphosis $<40^0$ at the time of presentation. Minimum followup was eighteen months with the mean followup being forty months. Of the seventy patients, eleven had involvement at the thoracolumbar junction while the others had thoracic lesions. They successfully treated all but one of these seventy patients with nonoperative treatment. The single patient who underwent surgery in their group was recommended the same in view of neurological deterioration while on treatment. Among the sixty-nine patients treated nonoperatively, the mean progression of kyphosis was only 5^0. There was one 28-years old woman with midthoracic lesion with pretreatment kyphosis of 25^0 that progressed to 45^0 at the end of one year and was static thereafter for two years. She had no neurological or pain-related complaints due to the same.

In 2007, Kotil K et al did a study similar to the above one[11]. They treated forty-four adult patients with spinal tuberculosis. There were eighteen, sixteen and ten cases with involvement of thoracolumbar junction, thoracic and lumbar spine respectively. They included patients with kyphosis at presentation being $<30^0$. Kyphosis was calculated by adjusting local spinal sagittal profile; by subtracting 5^0 for every thoracic level and by adding 10^0 for every lumbar level. Over a follow-up period of forty months, kyphosis increased by a mean of only 10^0, from mean of 11^0 to mean of 21^0. Two patients had kyphosis of 30^0 and 32^0 at the end of treatment. However, they refused surgery for the same.

Guo Y et al did a comparative study between a group of 89 patients treated with conventional conservative treatment and another group of 31 patients treated with CT-guided locally instilled antibiotics[12]. They however, chose patients with kyphosis $<30^0$ as an inclusion criterion for both groups. There was a mean 6^0 progression of kyphosis in this group from mean 6.25^0 at the start till mean 12.36^0 at the end of treatment. Out of the 89 patients treated with traditional conservative method, four patients were subsequently operated upon in view of progression of disease due to drug resistance.

Oguz et al proposed GATA classification for deciding the ideal treatment strategy in spinal tuberculosis[13]. In terms of kyphosis as a determinant in this classification, they proposed surgery for kyphosis with sagittal index $\geq 20^0$. Based on these criteria, they selected only five out of 76 patients in their study population for nonoperative treatment. They however, did not provide details about outcomes specific for these patients managed without surgery.

Zhang Z et al presented their study comprising of 89 patients with mild spinal tuberculosis treated with nonoperative method[14]. They included patients with kyphosis $<30^0$. Over a followup period of minimum two years [range: 24 to 50 months], mean Cobb angle increased by about 6^0 from mean of 6.25^0 to mean of 12.36^0. Out of these, they had 23 patients with $>10^0$ of progression of kyphosis. Despite this progression, they had no functional consequences due to the same. Four of the total 89 patients underwent surgery. However, the authors did not detail the indications for surgery for these patients in their article.

Aggarwal A et al did a retrospective study of nonoperative treatment of thirteen patients with subaxial cervical spinal tuberculosis[15]. In addition to anti-tuberculosis treatment, nonoperative treatment was in the form of application of cervical traction using tongs for 8-12 weeks, followed by mobilization with four-post cervical collar for another three months. Mean age was 20 years [range: 9 to 34 years]. Mean pre-treatment kyphosis was 17^0 [range: 43^0 kyphosis to 29^0 lordosis]. Over a minimum follow-up period of one year, there was a mean improvement of 7^0. Mean residual kyphosis was 4.7^0 [range: 34^0 kyphosis to 30^0 lordosis]. While eleven patients had improvement in kyphosis, only two patients had worsening of kyphosis. One patient deteriorated from 4^0 kyphosis to 8^0 kyphosis while another one deteriorated from 16^0 kyphosis to 36^0 kyphosis. All patients showed remarkable neurological recovery with this treatment. However, the authors did not detail any functional consequences of residual kyphosis in these patients, nor was any detail mentioned regarding the likely cause of deterioration in deformity in those two patients.

Conclusion:

For paediatric population, though spine-at-risk signs are the most reliable indicators to identify patients likely to worsen; existing data suggests that kyphosis $>30^0$ in this age group can be considered an ideal indication for surgery[5, 9]. For adult population however, there is literature to demonstrate good outcomes with nonoperative treatment even in adult patients with $>30^0$ kyphosis[9, 10, 15]. This is true for involvement across subaxial spine extending upto lumbar spine. Since there is some literature to reveal poor long-term functional consequences of adult kyphosis $>60^0$, it would be more appropriate to consider this as a critical cut-off for degree of kyphosis alone as an indicator for surgery in adult patients[4].

In view of physiological lordosis, it would be prudent to consider adjustment in the above kyphosis values though there is no unequivocal evidence to suggest how much should be the adjustment at each level in this situation[7, 11].

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