mean follow-up 13 months) [5,6]. One study compared three different types of cages (titanium mesh, titanium and PEEK) versus autologous iliac bone strut [7]. All received posterior screw fixation. There were no significant differences in clinical or radiographic outcomes, and infections were judged cured in all at a mean of 36 months for follow-up. Multiple other studies report similar findings [8–10].

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1.4. PREVENTION: RISK FACTORS

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QUESTION 1: Does prior or active tuberculosis (TB) preclude patients from undergoing spine surgery?

RECOMMENDATION: Prior or active TB does not preclude patients from undergoing spine surgery.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

The mainstay of treating spinal TB is chemotherapy [1]. Almost all antituberculous drugs penetrate well into tuberculous lesions [2], more than the desired minimum inhibitory concentrations (MIC) [3,4]. Abscesses usually resolve with medical therapy, as antituberculosis drugs penetrate very well [5,6].

There is controversy in the literature about the necessity of using surgical intervention in addition to spinal TB treatments. A Cochrane Database Review assessing the role of routine surgery in addition to chemotherapy in spinal TB including the studies from Medical Research Council (MRC) of the United Kingdom failed to reveal any statistically significant differences in various outcomes for additional surgery including: kyphosis angle, neurological deficit (none went on to develop this), bony fusion, absence of spinal TB, death from any cause, activity level regained, change of allocated treatment or bone loss [1]. Myelopathy with or without functional impairment most often responds to chemotherapy [7]. In two MRC studies conducted in Korea, more than 80% of patients had complete resolution of myelopathy or complete functional recovery when treated medically [8,9].

Though the review of the above trials was insufficient to say routine surgery early on was beneficial, several limitations exist [1]. First, two sets of trials reviewed in the literature were performed during the 1960s and 1970s, while in recent years new medications and better operative techniques have been developed. Second, the patients included in the MRC study were limited to two-vertebra disease with or without mild neural deficit [10,11]. The results for patients with moderate to severe motor weakness were not addressed. Moreover, the patients seen in developing countries often have a large number of vertebrae involved, accompanied with a greater chance of kyphosis progression [12] and late onset paraplegia [13,14]. Third, late onset paraplegia usually become present more than 15 years after initial spinal infection [15–17]. In MRC studies, increased progression of kyphosis was seen in the conservatively-treated group with a lower fusion rate during their follow-up period [18]. Considering the difficulties in treating severe late symptomatic post TB kyphosis, the follow-up period in these studies could be insufficient to detect the magnitude of late complications. Fourth, it is generally known that some patients do not respond well to conservative treatment and are considered nonresponders [19]. For these patients, surgery should be considered to procure adequate tissue to ascertain the diagnosis as well as to reduce the disease load.

Potential benefits of surgery include less kyphosis, immediate relief of compressed neural tissue, quicker relief of pain, a higher percentage of bony fusion, quicker bony fusion, less chance of relapse, earlier return to previous activities and less bone loss [1,2]. Early surgical intervention for prevention of deformity is relatively simple and may prevent late neurological problems due to kyphosis of the spine [15,20,21]. From a review of 124 articles, 17.1% of the procedures were performed with defined indications including: etiology, neurological deficit (severe or progressive), spinal instability with or without kyphosis (severe or progressive), multisegmental disease and paraplegia of greater than three months [19]. Surgical interven-

tion for those without neurological recovery/improvement after chemotherapy for moderate motor weakness and surgical decompression of the cord under the cover of multi-drug chemotherapy for severe motor weakness irrespective to the duration of illness or cause, are also recommended [22].

Medical treatment is generally effective for those with or without mild neural deficit. Surgical intervention may be indicated in advanced cases with marked bony involvement, abscess formation or paraplegia, regardless of prior or active tuberculosis.

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QUESTION 2: Should routine methicillin-resistant *Staphylococcus aureus* (MRSA) screening be in place prior to spine surgery?

RECOMMENDATION: Routine MRSA screening should not be performed prior to spine surgery. However, in hospitals with a high incidence of *S. aureus* spinal surgical site infection (SSI) and particularly high rates of MRSA infections, MRSA screening might be useful.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 86%, Disagree: 7%, Abstain: 7% (Super Majority, Strong Consensus)

RATIONALE

According to a recent review of 161 studies, the pooled average of SSI in spine surgery was 1.9% (range: 0.1 to 22.6%) [1]. Instrumented spinal fusion had the highest rate (3.8%), followed by spinal decompression (1.8%) and spinal fusion (1.6%). *S. aureus* contributed to almost 50% of spinal SSIs with a range of 0.02 to 10%. Among *S. aureus* spinal SSIs, the pooled rate of MRSA infections was 38% [1]. The 30-day mortality rate among patients with SSI was 1.06%, double that of those without SSI (0.5%), with mortality increasing with the complexity of spinal surgery or with the presence of underlying diseases [2]. Moreover, SSIs increased re-admission rates (from 20–100%), reoperation rates (with a pooled average of 67%) and doubled health-care costs [1].

Preoperative nasal carriage of *S. aureus* has been shown to be a risk factor for SSI, but rates have been variable between studies [3,4]. Nasal decolonization with the use of topical mupirocin is utilized in 90% of cases, however, the impact of using this strategy on the reduction of SSIs in orthopaedic surgery have reported conflicting results [5,6]. A recent meta-analysis of all published studies in cardiac and orthopaedic surgery suggested that decolonization was associated with a significant decrease in *S. aureus* SSIs when either the intervention was applied to all patients or only to those who were nasal carriers [7]. Another meta-analysis showed that an absolute reduction in SSIs of 1% may be cost-effective, however, universal decolonization may increase the risk of mupirocin resistance [8].

In a not-yet published retrospective study of 1,749 patients scheduled for elective instrumented neurosurgery, the MRSA colonization rate was 0.74%. After decontamination, all MRSA carriage was eliminated and none of the 13 MRSA carriers developed an SSI, while only 1 MRSA-negative case developed a MRSA SSI.

In a recent retrospective study of 4,973 consecutive spine patients who were given cefazolin as prophylactic antibiotic therapy rather than topical nasal antibiotics for decolonization, 49 (1.1%) were MRSA carriers, and 94 (2.1%) developed an SSI, 11 of which were caused by MRSA [9]. The SSI rates were similar in nasal carriers compared to non-MRSA carriers (3 of 49 vs. 91 or 4,433, $p = 0.13$) and nasal carriage was not a risk factor for spinal SSIs.