Review Article

Complications of adult spinal deformity surgery: A literature review

ABSTRACT

Purpose: Adult spinal deformity incidence increases accordingly as the population ages. Even though surgery is the best option for the treatment, the complications due to surgery are pretty challenging. This study aims to review the complication rates of adult spinal deformity surgery.

Methods: A literature review of the last decade was performed searching for the query "Adult spine deformity and complication." This search yielded 2781 results, where 79 articles were chosen to investigate the complications of adult spinal deformity surgery. In addition, the demographic data, surgical interventions, and complications were extracted from the publications.

Results: A total of 26,207 patients were analyzed, and 9138 complications were found (34.5%). Implant failure, including screw loosening, breakage, distal and proximal junctional kyphosis, were the most common complications. The neurologic complications were about 10.8%, and the infection rate was 3.6%. Cardiac and pulmonary complications were about 4.8%.

Discussion: Age, body mass index, smoking, osteoporosis, and other comorbidities are the significant risk factors affecting adult spinal deformity surgery. Presurgical planning and preoperative risk factor assessment must be done to avoid complications. Furthermore, intra and postoperative complications affect the patients' quality of life and length of stay, and hospital readmissions. Revision surgery also increases the risk of complications.

Conclusion: Good patient evaluation before surgery and careful planning of the surgery are essential in avoiding complications of adult spinal deformity.

Keywords: Adult spinal deformity, proximal junctional kyphosis, sagittal balance, spinal infection, spine surgery complications

INTRODUCTION

Adult spinal deformity is a complex disease causing pain and balance problems in the elderly population.[1,2] The prevalence of adult spinal deformity was found to be between 2% and 32%.[3] The surgery aims to correct and prevent the progression of the deformity, relieve pain, and decompress the associated stenotic spinal canal.[4] The main concerns are to restore sagittal and coronal balance, achieve fusion, and improve neurological status.[5-7]

Surgical approaches for adult spinal deformity include open procedures, minimally invasive surgery, and hybrid methods. Complications in adult spinal deformity surgery are vast, described heterogeneously, and reported without any categorization.

Most studies focus on main complications with a limited follow-up. Advanced age, comorbidities, nutrition, obesity, length of fusion, and sagittal balance are reported risk factors for most complications.[8] In a multicenter study of 306 patients, the overall complication rate was reported as 39%, and the reoperation rate was 26%.[9] Mechanical failure, with an incidence

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of up to 39%, is one of the most common complications in adult spinal deformity.[10,11] Thus, adult spinal deformity is a challenging disorder to treat for spine surgeons. The complications have a significant impact on quality of life, length of stay, and hospital readmissions. Thus, the main risk factors and complication avoidance should be taken into consideration.

This study investigates the significant complications in adult spinal deformity through the analysis of the literature during the last decade and tries to outline the measures of how to avoid them.

METHODS

We did a PubMed and Medline search with the query "Adult spine deformity and complication." The first search gave 2781 results. The retrospective and prospective articles written in English which were published in 2011 and later, that have a minimum follow-up of 30 days were included in this study. Papers containing patients <18 years and case reports were excluded. There remained 176 studies plus 44 studies from other sources. After screening the abstracts, 79 articles remained of which including 8 prospective and 71 retrospective studies [Figure 1]. All the studies were categorized according to the level of evidence and methodology [Tables 1 and 2].

We extracted the number of patients, number of revisions, type of surgical techniques used, the mean age of patients, number of fused levels, number, and types of complications extracted from the articles.

RESULTS

As a result of the literature mentioned above review of the last 10 years, 79 articles were included in the current study. Eight of the studies were prospective, and the remaining 71 studies were retrospective.

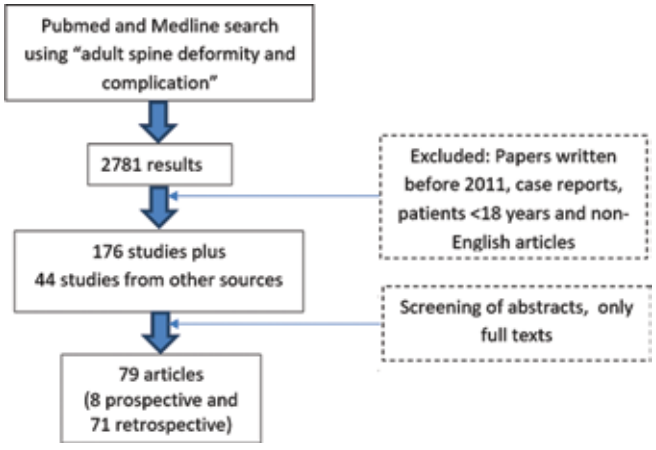

Figure 1: Flowchart used for literature search

A total of 26,207 patients were analyzed with a mean age of 59.8 years. The mean number of levels fused was 9.3; however, this number includes both anterior and posterior surgeries. The mean total blood loss was 1592.72 ml, and the mean whole operation time was 410.76 min. The follow-up time ranged from 30 days to more than 5 years [Table 3].

A total number of 9138 complications (34.5%) were reported. The most common complication was implant failure, including screw loosening/breakage, proximal junctional kyphosis (PJK), and distal junctional kyphosis (DJK). Cardiac and pulmonary complications were the most common systemic complications, 0.4%–26% and 0.1%–26%, respectively. The neurologic complication rate was between 0.3% and 35.5%, including nerve root injury, spinal cord damage, and cauda equina syndrome. We found reoperation rates between 10.3% and 53.7% in all series [Table 4]. We only included the series with a follow-up time of at least 12 months to find the accurate revision rates.

DISCUSSION

Adult spinal deformity becomes more common due to the aging of populations. As the fusion techniques are widely used, the number of complications encountered

Table 1: The articles classified according to level of evidence

Level of evidence	Number of articles (total 79)
2	2
3	58
4	19

Table 2: The articles classified according to methodology

Study design	Number of articles
Prospective, multicenter	4
Prospective	4
Retrospective	48
Retrospective, multicenter	13
Retrospective review of prospective database	5
Retrospective review of prospective database, multicenter	5

Table 3: Summary of the literature review

Patient data	Values
Total number of patients	26,207
Mean age	59.8
Number of segments fused	9.3
Mean operation time (min)	410.76
Mean blood loss (mL)	1592.72
Mean follow-up time (months)	28.85
Total number of complications (%)	9138/26,207 (34.8)
Total number of revision surgery* (%)	2334/13,067 (17.8)

*We included the series with 1 year or more follow-up times

Table 4: Rates of some common complications after adult spinal deformity surgery

	Number of studies examined	Range of complications (%)	Average percentage of complications
Systemic complications	37	0.1-26	4.8
Cardiac	23	0.4-26	5.9
Pulmonary	32	0.1-26	7.6
DVT	24	0.1-11.5	2.9
Renal	13	0.3-7.8	2.1
Delirium	10	0.3-7.8	2.3
Neurologic complications	40	0.3-35.5	10.8
Infection	33	0.3-12.9	3.6
Superficial	23	0.3-8.5	2.8
Deep	28	0.5-12.9	4.1
Implant failure	59	0.7-62.5	15.3
Screw loosening	20	0.6-48.5	11.1
Rod/screw breakage	26	1.7-31.7	13.5
PJK	53	0.7-62.5	17.1
DJK	5	0.7-6.8	2.6
Revision surgery[a]	45	10.3-53.7	17.8

[a]Only series with 1 year or more follow-ups were included. DVT: Deep vein thrombosis, PJK: Proximal junctional kyphosis, DJK: Distal junctional kyphosis

also increases.[8,12,13] Age, gender, comorbidities, body mass index, smoking, duration of symptoms, number of fused levels, operative time, and blood loss are considered for the risk factors in adult spinal deformity.[12-16] Montgomery *et al*. compared genders regarding complications and outcomes of adult spinal deformity surgery and found no significant difference between the two groups.[2] The reports searching for the effect of obesity on complication rates are contradictory. In one study using minimally invasive surgeries, obesity did not significantly differ in outcomes and complications.[17] However, Yagi *et al*. reported that Oswestry Disability Index (ODI) scores were worse in obese and overweight patients.[18]

Intraoperative complications of adult spinal deformity surgery mostly encounter neurological impairment, dural tears, excessive blood loss, and systemic complications. Among postoperative complications, wound infection should be added to that list. In the long term, pseudoarthrosis, instrumentation failure, adjacent segment disease, and proximal junctional kyphosis are frequent. Revision surgeries are also associated with increased complications.[8,16] Kasliwal *et al*. reported that prior spine surgery did not significantly affect complication rates and clinical improvement compared to primary surgery.[19]

Lee *et al*.[20] studied the 90-day readmissions. The readmission rate was 7%, and the reoperation rate was 5.3%. The wound infection, acute PJK and implant failure, lumbar radiculopathy, and dural tear were the most common reasons for readmission. The risk factors were long operation time, comorbidities like pulmonary or gastrointestinal problems, and osteopenia-osteoporosis.[20]

In studies where osteotomies corrected adult spinal deformity, the most common short-term complications were a dural tear, wound infections, implant failure, and new neurologic deficit.[21,22] We found the overall complication rate 52.8% in the osteotomy group, and the revision rate was 21.1%.[23]

Smith *et al*. showed that 69.8% of patients were affected by at least one complication at a minimum of 2-year follow-up, where older patients were at more risk.[3] The most common major complication was related to implants, where rod breakage was seen the most. To prevent rod breakage, multi-rod construct strategies were developed. The second most common complication was PJK. The most common operative complication was excessive blood loss. The infection rate was found at 9%.[3] Acosta *et al*. reported the long-term postoperative complication rate as 52% in patients over 75 years and concluded that elderly patients were at high risk for complications.[15] However, Lovato *et al*. compared age groups of 65–74.9 and ≥75 and showed no significant difference between the outcomes and complications.[1]

Uribe *et al*. found that the total complication rates were similar between hybrid and open groups.[14] However, there were more intraoperative complications in the open group. The total major complication rate was 46%.

Charosky *et al*. have reported an early infection rate of 4% and a late infection rate of 1.2%. Neurological complications were 7.5%. The pseudoarthrosis rate was 12.4%.[9]

Cho *et al*. stated that risk factors for perioperative complications are age, comorbidities, and obesity, and the surgery-related complication rate is 18.7%.[24] In follow-up, instrumentation failure rate depending on pseudoarthrosis was found as

13.3%. The adjacent segment degeneration rate was 6%. The long-term complications were mostly depended on the type of surgery.[24]

La Maida *et al*. reported an overall complication rate of 22%, with a high incidence of intraoperative complication with the pedicle subtraction osteotomies.[25]

Klineberg *et al*. reported the rates of complications as 30.5% intraoperatively, 48.5% perioperatively, and 58.7% postoperatively.[26] The most common intraoperative complications were excessive bleeding and dural tears, 11.4% and 6%, respectively. Postoperatively, PJK, rod breakage, and implant failures were seen chiefly.[26]

Anand *et al*. reported that direct lateral interbody fusion, axial lumbar interbody fusion, and posterior instrumentation with minimally invasive surgery (MIS) approaches improve functional outcomes and lower complication rates at long-term follow-up.[27] Khajavi and Shen also reported that a minimally invasive lateral approach for anterior lumbar interbody fusion reduces the complication rates.[28]

Adult spinal deformity surgery has many challenges regarding perioperative and postoperative complications, leading to low quality of life and financial consequences.[29] Therefore, it is essential to evaluate the risk factors and major complications to decide for patient.[14] Table 5 briefly explains the basic concepts to avoid complications.

We will report a review of the literature on complications in six groups: systemic complications, neurologic complications, infection, implant failure, and revision surgery.

Systemic complications

The most common systemic complication reported is pulmonary complications, with a rate of 7.6%. Cardiac complications, deep vein thrombosis (DVT), and renal complications are the other common complications. DVT before discharge was found 1.3% in a database search, and pulmonary embolism was 0.7%.[30]

Klineberg *et al*. reported that the most common intraoperative complication was excessive bleeding (11.4%) which may lead to massive blood transfusion and myocardial infarction, and other consequences.[26] DVT and pulmonary embolisms are the most common major complications in this study and impact length of stay and overall cost.[26]

The 30-day readmission rate found 7.5% in a study where the risk factors were obesity, pulmonary embolism, and peripheral vascular disease.[30] Infection, hematoma, and postoperative pain are the most common reasons for readmission.[30]

De la Garza Ramos *et al*. stated that the long-segment fusion operations are related to long operation times

Table 5: Some measures to avoid common complications after adult spinal deformity surgery

Systemic complications
Cardiac
Prevent excessive bleeding, apply less invasive surgery
Assess cardiac functions meticulously
Pulmonary emboli and DVT
Use compression stockings
Renal
Avoid excessive bleeding and fluid replacement
Frailty
Prehabilitation for frail patients
Delirium
Treat depression, early mobilization after surgery, psychological support
Less corticosteroids, decrease delirium-inducing medications
Neurologic complications
Intraoperative neuromonitoring
Use microscope during decompression
Avoid screw malposition by intraoperative fluoroscopy, navigation, EMG monitoring
Infection
Shorten the operation time, provide less bleeding
Weight loss against high body mass index
Good regulation of diabetes
Repair dural tears, use dural sealants
Avoid using steroids
Replace blood in case of low hemoglobin level
Apply minimally invasive surgeries
Preoperative antiseptic dressing
Prophylactic antibiotics
Intraoperative irrigation of the operation site with saline and antibiotics
Implant failure
Screw loosening, pseudoarthrosis
Manage osteoporosis before surgery
Use appropriate amount of bone grafts
Achieve a good sagittal balance
Rod-screw breakage
Use multi-rod constructs
Proximal junctional kyphosis
Provide sagittal balance
Augment cranial level with prophylactic vertebroplasty
Use hooks, wires, or polyethylene tethers at the upper end
Avoid excessive SVA corrections and excessive lumbar lordosis
Avoid soft-tissue and facet joint damage at the UIV
Good selection of end vertebra
Try less rigid fixations, flexible rods, hybrid constructs
Distal junctional kyphosis, caudal ASD
Use iliac screws to increase the strength on caudal level
Add interbody fusion to L5-S1 level

DVT: Deep vein thrombosis, SVA: Sagittal vertical axis, ASD: Adjacent segment disease, UIV: Upper instrumented vertebra

and higher blood loss. Hence, the morbidity rates are higher.[12] Lee *et al*. found that the most common nonsurgical complication was anemia due to excessive intraoperative bleeding.[20] Low levels of hemoglobin may delay wound healing.[13] Due to pulmonary disease, steroids could decrease bone mineral density and impairment in the healing of the wound.[12]

Minimally invasive surgical techniques are associated with less blood loss and less muscle damage.[31-33] Than *et al*. compared MIS to the hybrid group and revealed no significant difference in major complications and reoperations.[31] However, the MIS group had less blood loss and shorter operation time.[31] Kwan *et al*. reported that age, previous history of spine surgery, and American Society of Anesthesiologists (ASA) grades are risk factors for nonneurologic adverse events.[34] Preoperative evaluation of comorbidities such as cardiac failure, respiratory diseases, and renal functions is essential. Malnutrition is found to be related to nosocomial infections.[5]

As a result, excessive blood loss with transfusion might lead to fluid shifts resulting in cardiac, pulmonary, and renal problems. Blood transfusions also have risks for disease transmission and reaction.[35]

Another point that should be considered before surgery is the frailty (exhaustion) of the patient. If there is significant frailty, outcomes of any surgery are estimated to be worse.[36] The modified frailty index based on matching 11 variables from the Canadian Study of Health and Aging Frailty Index[37-39] has also been used in spine surgery.[39] The likelihood of complications was found 33.3% among frail patients and 4.2% among nonfrail patients.[39]

Another essential complication, especially in very elderly patients, is delirium after surgery. The prevalence of postoperative delirium in geriatric patients undergoing spine surgery is reported to be 12% to 24%.[40-42] Preoperative depression was an independent risk factor for postoperative delirium after elective spine surgery.[43]

Neurologic complications

The major reasons for adult spinal deformity surgery are pain, disability, and changes in the whole body's alignment. By correcting the malalignment, pain and functions may improve. Soroceanu *et al*. revealed that the ODI of obese patients compared to nonobese patients showed minor improvement.[44] Auerbach *et al*. showed that SRS pain, self-image, and subscore were improved in patients with medical complications after surgery.[45]

Tempel *et al*. demonstrated improvement in Visual Analog Scale (VAS) scores and quality of life assessments with lateral lumbar interbody fusion (LLIF) combined with posterior segmental instrumented fusion.[46] It is primarily due to the correction of spinopelvic biomechanics. Smith *et al*. reported that the oldest patient group had significant improvement in disability and pain compared to younger groups, even though they had more complications.[47] Improvement was seen in VAS and ODI in MIS groups.[31] Phillips *et al*. reported that VAS and ODI scores were better at 24-month follow-up time in patients treated with extreme lateral interbody fusion (XLIF), and 85% of patients were satisfied with the results.[48] Chen *et al*. also reported that postoperative ODI and VAS scores were better than preoperative scores.[49] However, Klineberg *et al*. said that postoperative complications worsened health-related quality of life compared with the noncomplication group at 2-year follow-up.[26] Besides, Núñez-Pereira *et al*. showed that patients with major complications have less functional improvement.[50]

Cho *et al*. revealed that younger patients with a primary surgery had better Scoliosis Research Society (SRS) and ODI scores than revision surgery patients.[16] However, Fu *et al*. reported that at 2-year follow-up, both primary and revision surgery groups had better ODI and VAS scores.[51] Scoli-RISK-1 study revealed that patient-reported outcomes were better at 5 years postoperative in ODI, Short Form 36, Physical and Mental Component Score, SRS-22r score, and Numerical Rating Scale for back/leg pain.[52]

After adult spinal deformity surgery, neurological impairments were among the significant complications that lead to less quality of life. This study revealed the overall neurologic complication rate as 10.8%. The primary neurological deficits could be the results of spinal cord ischemia, screw malposition, or retraction of neural tissues.[53,54] Minor deficiencies might be secondary to screw malposition, which could be solved with the aid of revision. Neurologic impairments could be avoided with neuromonitoring and less retraction. Zeng *et al*. recommend using somatosensory evoked potential and motor evoked potential monitoring routinely.[54] They reported better ODI scores, with a 92.6% satisfaction rate.[54]

Infection

Diabetes, obesity, previous spine surgery, significant blood loss, and prolonged operation time are the risk factors for wound infection.[55] The blood loss and transfusion were related to the increased incidence of delayed spinal infection.[35] De la Garza Ramos *et al*. suggest that

postoperative morbidity is the most important cause of surgical site infection.[12] Manoharan *et al*. studied the rate of 30-day readmission after adult spinal deformity surgery and stated that the most common indication was infection.[30] Soroceanu *et al*. found that in obese patients, the wound complication rate was higher.[44] Wound infection was one of the main causes of 30-day readmission to hospital.[13] Uribe *et al*. revealed the incidence of deep wound infection as 7.6%.[14]

Lee *et al*. reported that the complex surgeries with instrumentation were associated with long operation times and more blood loss making the patients more susceptible to postoperative infections.[29] Conversely, anterior fusion surgery has advantages with less blood loss, intact paraspinal muscles, lower risk of neurological deficits, and shorter operation times.[29]

MIS was also related to fewer intraoperative complications than the open group and was explained by less tissue disruption and lower blood loss.[14]

The analysis of the studies revealed a deep wound infection rate of 4.1% and a superficial wound infection rate of 2.8%. Proper patient selection, preoperative antiseptic dressing and antibiotics, intraoperative irrigation of the operation site with saline and antibiotics, shorter operating times, and less blood loss could prevent infections.

Implant failure

Mechanical implant failure incidence was found between 12% and 47% in postoperative patients.[56] The common complications that lead to implant failure are PJK and rod breakage.[57-59] In another study, the most common complication of implant failure was found PJK, with a rate of 17.1%.[60] The other common reasons were rod-screw breakage, screw loosening, and DJK.[60]

The risk factors for rod breakage are elderly patients, worse ASA score, obesity, long segment fusions, three-column osteotomy, the high sagittal vertical axis (SVA), thoracic kyphosis, over-correction, and sagittal malalignment.[44,57,59,61]

Guevara-Villazon *et al*. have used multi-rods and increased the load sharing to prevent implant failure.[57] However, Banno *et al*. said that, especially in osteoporotic patients, multi-rod constructs had a higher incidence of junctional screw loosening than two-rod constructs.[62] Denduluri *et al*. investigated implant-related complications in terms of mixed and same metal rod-screw constructs but found no clear evidence of increased risk of complications.[60]

The prevalence of PJK and pseudoarthrosis was 21.7% and 19.3%, respectively, and related to implant density and postoperative lumbar lordosis.[63]

According to Camino *et al*., proximal junctional kyphosis was one of the main reasons for early readmission to hospital.[13] The common risk factors are poor bone quality, infection, smoking, and hypercorrection of the spine in proximal junctional failure (PJF).[13,62,64-66] Furthermore, it is related to the disruption of posterior soft-tissue and ligamentous structures.[33,67] The radiologic risk factors for PJK were identified as excessive SVA corrections and excessive lumbar lordosis.[68,69] Recurrent PJK is associated with increased anterior malalignment, increased thoracic pelvic angle, and SVA.[36,70] In addition, it has been reported that the iliac screw loosening rate was 48.5% and related to sagittal malalignment, which might lead to PJK.[71]

Kim *et al*. reported that upper thoracic instrumentation did not decrease the rates of PJK.[68] However, when compared to lower thoracic instrumentation, overall complication rates were higher. Meanwhile, lower thoracic instrumentation also requires revision surgery, like upper thoracic instrumentation.[68] Ha *et al*. reported that distal thoracic PJK is related to compression fractures where the proximal thoracic PJK is related to subluxation.[67] Park *et al*. found that ligamentous failure (34.8%), bony failure as screw pullout, and vertebral fracture (65.2%) were the primary reasons behind PJK.[72] In Bhagat *et al*., facet joint damage at the top end of the construct, incorrect end vertebra selection, and proximal disc degeneration were found as the other possible causes.[53]

Bridwell *et al*. reported the risk factors as older age, short construction, obesity, and fusion to the sacrum with a prevalence of PJK $\geq 20^0$ as 27.8%.[73]

Hostin *et al*. recommended that bone density optimization before surgery and vertebral augmentation intraoperatively should avoid PJF.[74] Prophylactic vertebroplasty showed a lower incidence of PJK and PJF development.[75] Bone mineral density, albumin levels, or weight is associated with nutritional status. Osteoporosis is a risk factor for instrumentation failure.[61] Screening tests for osteoporosis for elderly patients should be done routinely.[5]

Pelvic fixation and multi-rod systems could be used to avoid adjacent segment implant failure and pseudoarthrosis.[57]

Pseudoarthrosis is seen mostly 1 year after surgery as the failure of solid fusion. Caputo *et al*. found a pseudoarthrosis

rate of 11.8% in their series surgically treated with XLIF, which is lower than other studies compared.[76]

In their study, Bae *et al*. stated that patients who underwent LLIF + posterior segmental fixation (PSF) had lower PJK and mechanical failure rates at the upper instrumented vertebra.[77] However, overall complication rates were found similar. Revision due to PJK was higher in the PSF-only group. Barton *et al*. found a mechanical complication rate of 43.6%, where vertebra fracture and PJF were the most common ones.[78] Sagittal imbalance severity and insufficient correction, preoperative comorbidities, and pseudoarthrosis are linked to mechanical complications. Yagi *et al*. showed that in their study with long-term follow-ups, 76% of PJK occurred within 3 months of operation, and they also reported that PJK is seen mainly in patients with osteoporosis.[79] Other risk factors for PJK include posterior fusion, fusion to sacrum, and inappropriate global spine alignment.[79,80]

Mummaneni *et al*. compared MIS and hybrid surgery groups and showed no significant difference in the development of PJK in both groups.[81]

DJK is defined as more than a 10° increase in kyphosis postoperatively and pullout of lowermost screws in the follow-ups.[82,83] Distal junctional failure (DJF) was seen with vertebral fracture, spondylolisthesis, and stenosis at the lowest instrumented fused level. The common reasons behind DJF were as follows: screw loosening, screw pullout from the sacrum, ilium, rod breakage, and iliac bolt connector failure.[77]

Revision surgery

The need for revision surgery is mostly seen after adjacent segment disease, PJK, and nonunion.[4,58] Correction of deformity in the sagittal and coronal planes is essential to decrease the revision rates. Longer constructs have higher pseudoarthrosis and revision rates.[84] With iliac screw insertion, the reoperation rate was reported as 17.7% due to increased biomechanical stability and fusion.[85]

De la Garza Ramos *et al*., in a study of three-column osteotomy, found the revision rate as 26.4%.[12] Bianco *et al*. reported the reoperation rate as 19.4%.[86] However, they did not state the indications of reoperations. Scheer *et al*. reported the reoperation rate as 5%, with the most common indications as neurological findings and instrumentation failure.[87] Hassanzadeh *et al*. found the revision surgery rate after three-column osteotomy as 12%.[88] This study revealed the overall revision rate as 17.5%, consistent with the literature.

Revision surgery for rod breakage with pseudoarthrosis is reported low with multi-rod systems.[57] Hamilton *et al*. found that the rate of revision surgery was high in a hybrid group compared to the PSF group, only.[89] It was stated that PJK was the common reason for revision surgery in both groups. PJK development was multifactorial and depended on the number of levels fused, the rigidity of the construct, bone quality of the patient, and sagittal balance correction.[89] The lumbar lordosis concerning pelvic incidence is a more powerful radiographic parameter that predicts postoperative success.[46]

Mechanical complications such as PJK and rod breakage cause an increased risk of reoperation (32%–72%).[26] In addition, Lee *et al*. reported that long operation time and history of DVT/pulmonary emboli increased the risk of reoperation by 5.8–8.7-fold, causing mostly wound complications.[20]

CONCLUSION

Adult spinal deformity is a challenging disease both in planning the treatment and coping with the complications. Comorbidities have been shown to lead to readmissions and reoperations. Preoperative evaluation of comorbidities and the presence of osteoporosis should be carefully examined before adult spinal deformity surgery to decrease complications. Minimally invasive techniques could be helpful in selected cases. For example, PJK, vertebra fracture, and instrumentation failure could be avoided with adequate sagittal imbalance and spinopelvic alignment.

Although many reports tell that patient satisfaction is not as high as deformity surgeries in young ages, spine surgery in adult deformities can achieve satisfactory results with good patient selection and meticulously obeying all measures to lower the complication rates.

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Conflicts of interest

There are no conflicts of interest.

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