

Surgical Approach Selection for Adults Cervical Trauma: The Evidence Based Controversies for The Last 20 Years

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Abstract- Background

The current management of various cervical trauma is still being disputable between spine surgeon due to lack of cervical treatment consensus, remarkably related to surgery determination and surgical approach preference. Thus, each surgical approach is unlike and comprises some advantages also drawbacks.

Aim

The purpose of this study is to compare various surgical technique and define which procedure will result a better outcome.

Materials and Methods

The determination of pertinent studies was administered following to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The applicable reports were assembled thorough a meticulous searched using PubMed, Science Direct, Medline, Cochrane Library databases, trial registries and the reference list of reports until August 2020. We analyzed the pre-postoperative neurological assessments, intraoperative complications, surgical time period, estimated blood lost, clinical scores, imaging, fusion rates

Result

The preliminary search revealed 116 inherent articles. Thus, we attained 8 matched studies (491 total samples). The anterior technique yields a better fusion rate particularly in the burst fractures, cervical facet dislocations, odontoid fractures and flexion distraction injuries. On contrary, in more severe translation, posterior and combined approach may become the treatment options.

Conclusion

Based on included studies, five studies stated that the anterior approach in cervical injury has been proved to have a higher success rate than posterior approach or combined approach. However, the approach selection depends on the surgeon's experience and the cervical fracture pattern.

Index Terms- cervical trauma, anterior technique, posterior technique, combined techniques, cervical surgical instrumentation

I. INTRODUCTION

Cervical trauma is the most common cause of disabilities, which often leads to the devastating health problems particularly in the younger age less than 40 years old. The high energy injuries are often associated, especially caused by motor vehicle accidents (39.5% to 55%), violence (14.9 to 29.5%), falls from height (18.8% to 23%), and sport injuries (7.3% to 11.1%) which result the irreversible spinal cord injury and a debilitating condition. Cervical fractures are the most challenging issue in the developing country. Trauma over vertebral column is around 6 % from the total cervical fractures, more than 50% cases involve trauma to the spinal cord and adjacent structures. The occurrence of Spinal Cord Injuries (SCI) ranges between 27 until 47 cases per million populations, nearly 10% of a total cervical trauma is categorized as a poly-trauma patient; approximately less than 50% cases are associated with neurological deterioration.¹⁻⁴

The mechanism of injury, a motoric and sensory assessment has a direct correlation to confirm the anatomical involvement. The upper cervical and sub-axial cervical have a different anatomical feature, for the example, the upper cervical (C1 and C2) have a wider diameter than the lower cervical, this peculiarity is being correlated with low risk injury to the spinal cord in the upper segment. The most frequent location of injury in cervical trauma is the atlantoaxial segment followed with sub-axial cervical in C6-7.^{4,5}

A preliminary evaluation, an appropriate imaging, a precision diagnosis and management take the major part to dictate cervical trauma prognosis. The prevalence of reported missed trauma ranges from 4% to 30%. Reported as a frequent reason is due to the insufficient imaging evaluation. The odontoid, teardrop, facet and hangman's fracture is the hallmark cervical injury pattern which are usually overlooked. However, with suitable guidance and treatment, the risk of neurological impairment can be remarkably reduced.

Furthermore, an ideal imaging acts as a cardinal key to regulate the extensions of cervical trauma and what the anatomical part is being involved.⁵

Some classification has been designated to classify numerous types of fracture in regard to specify the prompt treatment and acknowledge some differentiation of the each technique's characteristic results in varies cervical fractures. The current common classification for cervical fracture are the Sub-axial Cervical Spine Injury Classification (SLIC) and the *Arbeitsgemeinschaft für Osteosynthesefragen* (AO) cervical fracture classification.⁶

The earliest management is decompression over neural elements in spinal cord, which is best achieved using traction, typically applied with tongs. Relates to several type cases such as a bilateral facet dislocation, flexion distraction injury and the other severe damages, this act may not help to reduce neurological deficits. Neurological unresolved and evolved to spinal cord compression may become the absolute indication to urgent surgical reduction with the suitable techniques. A surgical technique in unstable cervical injury has undertaken many proceed, comprising the applicable of instrumentation to relay instant stability and accomplish cervical alignment to nurture bone incorporation. For the anterior technique, the utilization of anterior cervical plating, whereas, in *in vitro* research, posterior lateral mass screw, plate and rod application are well recognized as a higher-ranked of biomechanically stable than other techniques. Nevertheless, the affirmation study respecting to which approach to use in unstable cervical fractures and SCI are not being further established. Thus, each technique, anterior and posterior approach have its popularity to acquire stability and carry out a fusion. For anterior technique, reconstruction in anterior column can be performed directly, less muscle will be split and uncomplicated dissection over anterior part. Previous studies provoke that anterior approach is more tolerable post-operatively for most of the patients. On contrary, some authors disclosed that posterior approach attained its popularity because this technique yielded the higher rate of union and a good clinical result.^{1,2,6-9}

The accepted guidance for upper and lower cervical fractures has shortage studies amidst the orthopedic surgeons, specifically to determine the surgical and non-surgical indication, thus, which surgical techniques are applicable and yield to restore anatomical function. The lack of standard glossary and cervical trauma scoring system is the paramount drawbacks of cervical fracture treatments.^{1,2,6-8}

Consequently, the aim of this study is to validate the differentiation between anterior, posterior or combined fixation in diverse cervical fractures because limited studies have been found to systematically review these approach, to particularly elucidate its varies outcomes from pre-postoperative neurological assessment, intraoperative complication, surgical time period, estimated blood lost, clinical score (Japanese Orthopedics Score/ JOA, American Spinal Cord Injury Association/ ASIA, Frankel score, Neck Disability Index/ NDI), imaging judgement and fusion rates.

II. MATERIALS AND METHODS

Search Strategy

The determination of pertinent studies was administered following to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The applicable reports were assembled thorough meticulous searched using PubMed, Science Direct, Medline, Cochrane Library databases, trial registries and reference list of reports until August 2020 to distinguish all of the published literature which has documented the numerous cervical surgical technique in adult cervical trauma cases. We screened the qualified studies criteria using Boolean Operator. The keywords are *Anterior approach OR anterior technique OR anterior decompression stabilization fusion AND posterior approach OR posterior technique OR posterior decompression stabilization fusion AND cervical trauma OR cervical injury OR spinal cord injury cervical OR cervical facet dislocation OR cervical fracture*^{10,11}

All immanent sections of literatures including study eligibility, qualification, trial object and selection, variables data, assessment risk of bias and irrelevant data studies were conducted by independent authors. Identical, equivalent and irrelevant studies were withdrawn. Titles and abstracts were analyzed. Furthermore, the final studies have undertaken all-inclusive screening for this review's criteria.

Table 1. Boolean Operators

Search engine	Key Words	Result
PubMed	<i>Anterior approach OR anterior technique OR anterior decompression stabilization fusion AND posterior approach OR posterior technique OR posterior decompression stabilization fusion AND cervical trauma OR cervical injury OR spinal cord injury cervical OR cervical facet dislocation OR cervical fracture</i>	54
Science Direct	<i>Anterior approach OR anterior technique OR anterior decompression stabilization fusion AND posterior approach OR posterior technique OR posterior decompression stabilization fusion AND cervical trauma OR cervical injury OR spinal cord injury cervical OR cervical facet dislocation OR cervical fracture</i>	36

Cochrane	<i>Anterior approach OR anterior technique OR anterior decompression stabilization fusion AND posterior approach OR posterior technique OR posterior decompression stabilization fusion AND cervical trauma OR cervical injury OR spinal cord injury cervical OR cervical facet dislocation OR cervical fracture</i>	17
Medline	<i>Anterior approach OR anterior technique OR anterior decompression stabilization fusion AND posterior approach OR posterior technique OR posterior decompression stabilization fusion AND cervical trauma OR cervical injury OR spinal cord injury cervical OR cervical facet dislocation OR cervical fracture</i>	9

Methods

The specification criteria for literature consideration to this review

Types of studies

The liberated author included Randomized Controlled Trial (RCT), quasi-randomized (non-randomized population) and the experimental design with a maximum level II evidence (Table 2). The level of selected study’s evidence was categorized on the behalf of the criteria authorized by the North American Spine Society and the Oxford Centre for Evidence Based Medicine: ¹⁰⁻¹³

1. Level I: High quality randomized trial or prospective studies, about previously testing in developed diagnostic criteria on consecutive patients, sensible costs and alternatives; values obtained from many previous studies with multiway sensitivity analyses; systematic review of Level I Randomized controlled trials (RCTs) and Level I studies

2. Level II: Lesser quality (RCT); prospective comparative study; retrospective study untreated controls from an RCT; lesser quality prospective study; development of diagnostic criteria in consecutive patients; sensible costs and alternatives; values obtained from limited studies; with multiway sensitivity analyses; systematic review of Level II studies or Level I studies with inconsistent results.

Types of populations

We specified all of the literature which analyzed human study in relate to adult with confirmed cervical trauma, varies from distraction-flexion dislocation, sub-axial cervical fracture dislocation, cervical burst fracture, odontoid fracture, atlanto-axial fracture accompanied with or without neurological involvement. The minimum post-operative evaluation is three months.

Types of interventions

Characteristic were comparative trials between different surgical techniques for those fractures. The principal comparative was the anterior versus posterior technique with the application of open or closed reduction followed with fixation.

1. Anterior surgical techniques:

- Open anterior cervical reduction and fixation
- Closed anterior cervical reduction and open surgical fixation

2. Posterior surgical techniques

- Open posterior cervical reduction and fixation
- Closed posterior cervical reduction and open surgical fixation

3. Combined techniques (Started with closed reduction)

- Anterior-posterior
- Posterior-anterior

4. Combined techniques (Open reduction)

- Anterior-posterior
- Posterior-anterior

Types of result evaluation

Primary outcomes

- Post-operative neurological and clinical assessment (American Spinal Cord Injury Association/ ASIA, Frankel classification, Japanese Orthopedics Score/ JOA, Neck Disability Index/ NDI)

Secondary outcomes

- Intraoperative evaluation (surgical time period, estimated blood loss)
- Length of stay (LOS)
- Neck-pain (Visual Analog Scale/ VAS)
- Radiographic assessment (sagittal alignment, cobb angle, bone fusion rates)

We included all studies which measured the primary or secondary outcome alone

Table 2. Validity Search Methods

Authors	Journal	Description Study	Conclusion	Model	Level of Evidence
Brodke et al (2003)⁷	Journal of Spinal Disorders & Techniques	Randomized comparative study of anterior vs posterior approach in unstable cervical injuries and associated spinal cord injuries	There were no significant differences in fusion rates, alignment, neurologic recovery, or long-term complaints of pain in patients treated with either anterior or posterior fusion and instrumentation	Human	II
Toh et al (2005)¹⁴	Journal of International orthopedics	Retrospective comparative study. Anterior vs posterior or combined instrumentation in the burst fractures or teardrop dislocation fractures over middle and lower cervical spine	Based on the anatomical and neurological findings, the study demonstrates that anterior fusion is preferable to posterior fusion for the treatment of burst fractures and tear-drop dislocation fractures of the middle and lower cervical spine.	Human	II
Song et al (2008)¹⁵	Journal of Clinical Neuroscience	Prospective comparative study of combined anterior and posterior fixation with anterior fixation alone in the distraction-flexion injury in the lower cervical spine	In those with a bilateral dislocation, the fusion time was increased when only anterior fixation/fusion had been performed but the clinical results, such as neurologic recovery and complications, were similar in the four groups. Overall, anterior fixation/fusion alone in a bilateral dislocation is recommended as an alternative method.	Human	II
Kwon et al (2007)²	Journal neurosurgery spine	A prospective randomized controlled trial of anterior compared with posterior stabilization for unilateral facet injuries of the cervical spine	both the anterior and posterior fixation approaches appear to be valid treatment options. Although statistical significance was not reached in the primary outcome measure, some secondary outcome measures favored anterior fixation and others favored posterior treatment for unilateral facet injuries.	Human	I
Yuan et al (2018)¹⁶	Journal of orthopedic Surgery and Research	Retrospective cohort study of anterior cannulated screws fixation and posterior instrumentation of C1-2 without fusion in the treatment of odontoid fracture	For fresh type II odontoid fractures, high rate of fracture union can be achieved by both ACSF and PIWF. For most fresh type II odontoid fractures, anterior screw fixation was the best option for its simplicity and preservation of normal atlanto-axial rotary function. Posterior instrumentation without fusion could preserve most of the atlanto-axial rotary function and lead to moderate neck discomfort and is also a good alternative if anterior screw fixation is contraindicated	Human	I

Liu et al (2019) ¹⁷	European Spine Journal	Retrospective comparative study. The anterior only approach vs the posterior – anterior approach in cervical facet dislocation	Compared with the conventional posterior–anterior approach, the novel anterior-only approach with two reduction techniques, including Caspar pins kyphotic Para median distraction and anterior facetectomy, achieved a 100% reduction success rate and induced less surgical trauma, indicating that this method can be recommended as an alternative for lower cervical facet dislocation.	Human	II
Luksanapruksa et al (2019) ¹⁸	Asian Spine Journal	Retrospective cohort study to compare posterior approach and combined approach of cervical fractures in ankylosing spondylitis	Both posterior and combined approach provided good clinical results. posterior surgery had lower EBL, lower postoperative complication rate, and shorter length of stay than combined approach surgery; none of these differences were statistically significant	Human	II
Ren et al (2020) ¹⁹	Journal of Scientific Reports	Prospective comparative study of long term outcome in anterior reduction and interbody fusion fixation vs posterior reduction and short segmental pedicle screw fixation for lower cervical dislocation	The posterior approach was associated with greater loss of alignment by two years (P = 0.012) and at final follow-up (P < 0.001). The posterior approach group had more blood loss (P < 0.001), longer operation times (P < 0.001), longer hospital stays (P < 0.001) The anterior approach is better than the posterior approach for preserving cervical lordosis, which is associated with a better long-term effect.	Human	II

Study Quality Assessments

We analyzed all of the published literature to assess its title and abstract which has matched with this review’s criteria. Moreover, the authors will extract all collected studies in respect of the inclusion basis. Quality appraisal and the content of included published literature were discussed until finalization of the highly qualified and eligible study to be reviewed.

All aspects of studies, including a methodological quality, variables data and risk of bias assessment, were appraised by each author with filling up forms. Forms were collected by the main author then all authors gathered to discuss any contradicting points.

III. RESULT

Search Result

Preliminary search revealed 116 inherent articles. The persisting data after eliminate identical studies were 60 articles. Moreover, we appraised all studies manually for its pertinence and qualification. Thus, we attained 8 matched studies (491 total samples) and reviewed several comparative surgical techniques in the different cases of cervical trauma. All articles had varied level of evidence, range from level I – II. Minimum duration of follow up is started as early as 3 months until 17 years

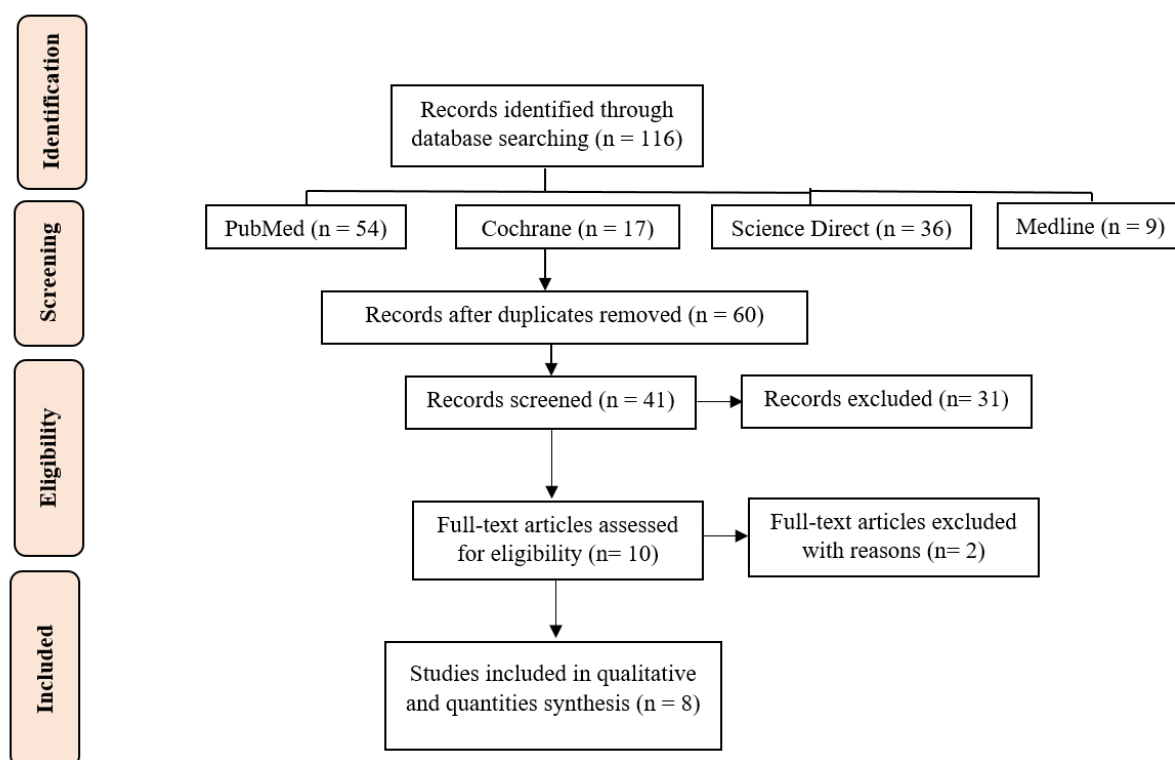


Fig 1. PRISMA Flow Chart Describing Search Process

Outcomes

Primary Outcomes

For the neurological post-operative parameters including Frankel, ASIA, JOA and NDI, there were neurological improvement in each group with no significant difference between those scores. In Brodke et al published literature, it has been analyzed that the anterior group, 70% of total patient improved minimal 1 Frankel grade and 57% in the posterior group. Toh et al study found that 9 of 24 patients treated anterior fixation has yielded the improvement of neurological outcome whereas the posterior group patients did not show any neurological improvement. No significant difference has been found in the case of unilateral and bilateral facet dislocation which treated with anterior technique only and combined technique. According to Yuan et al, anterior cannulated screw fixation (ACSF) and posterior instrumentation of C1-2 without fusion (PIWF) resulted an immediate spinal stabilization without neurologic deterioration. No significant difference among anterior-only group and anterior-posterior in cervical facet dislocation cases in respecting of Liu et al. Song et al also stated that no significant different in neurological outcome between the anterior fixation and combined approach with a cervical flexion-distraction injury. It also applied on Ren's studies, that there were no difference between anterior and posterior reduction with short segmental pedicle screw fixation in cervical facet dislocation. ^{1,2,7,14-18}

Secondary Outcomes

Brodke et al, there were 2 cases of pseudoarthrosis in the anterior group and none in the posterior group. No significant difference over neck pain, fusion rates, sagittal alignments and neurologic recovery. The restoration of spinal canal diameter has been achieved approximately 60 % in the anterior approach while the posterior approach has been restored spinal canal only 6% according to Toh et al study in the burst fracture and tear drop dislocation. As claimed by Song et al, a longer time of fusion rates in bilateral facet dislocation treated with anterior technique only than combined technique, whereas, no difference has been found among vertebral height, Cobb's angle, fusion rate and neurologic recovery in each approach. On the other hand, on the result study of Kwon et al, anteriorly treated patients cause less postoperative pain, a lower rate of wound infection, a higher rate of radiographically fusion and better alignment. Based from NDI score in Yuan et al, NDI in PIWF was statistically higher than ACSF. Liu et al has been analyzed that longer duration of surgical time and greater blood loss intra-operative in anterior-posterior approach than anterior-only. Nonetheless, Ren et al research showed that the posterior fixation consequence a greater loss of alignment, more blood loss, longer operation time and hospital stays than anterior technique. ^{1,2,7,14-18}

Table 3. Characteristic Outcome Studies

<i>Parameter</i>	Brodke et al (7)	Toh et al (14)	Song et al (15)	Kwon et al (2)	Yuan et al (16)	Liu et al (17)	Luksanapruksa et al (18)	Ren et al (19)
Sample size (M:F)	47 (37 : 10)	31 (29 : 2)	50 (40 : 10)	42 (31 : 11)	36 (28 : 8)	93 (80 :13)	33 (31 : 2)	159 (107 : 53)
Age	33 -38	14 – 69 Mean: 29.3	20 - 66	33 – 41.1	22 – 70 Mean: 41.5	21 - 73	42 - 85	19 - 76
MOI	- 33 MVA - 11 fall - 3 diving - 1 assault	- 21 MVA -10 fall	-37 MVA - 9 fall - 2 diving	N/A	- 14 MVA - 22 falls	- 24 MVA - 28 fall - 41 other	N/A	N/A
Cervical trauma	Bilateral facet fracture, burst fracture + bilateral facet disruption, burst fracture, unstable extension injury	Burst fracture and Teardrop dislocation fractures	Distraction flexion injury	Isolated acute unilateral facet dislocation	Odontoid fracture	Unilateral and bilateral facet dislocation	All cervical fractures	Unilateral/ bilateral dislocation with or without facet joint fracture between C3-T1
Involved levels								
C1-2					36			
C2-3								
C3-4	47	1				6	1	20
C4-5		2	13	6		13	9	49
C5-6		16	26	10		33	7	55
C6-7		6	9	25		33	14	31
C7-T1		6	2	1		8	2	4
Follow up	6 mo – 17 mo	6 mo – 14 yrs Mean: 23.5 mo	19 mo – 96 mo Mean: 47 mo	6 wks – 12 mo	3 mo – 60 mo Mean: 43.1 mo	12 mo	6.4 mo – 195.46 Mean: 69.9 mo P=0.88	10 yrs – 17 yrs P = 0.052
Interval injury surgery	< 5 days of injury (50% anterior, 70% posterior) > 5 days of injury (50% anterior, 30% posterior)	26 (four days of injury) 5 (elective surgery)	N/A	N/A	ACSF:5 days PIWF:14 days	N/A	1 – 7 days	3 days

Surgical techniques	-A:Anterior discectomy fusion -Posterior: Posterior decompression fixation fusion	- Group A: Anterior decompression fusions - Group B: Anterior decompression fusions - Group C: Posterior fixation + anterior decompression, posterior fusion alone	- Group A: anterior fixation/fusion (Allen stage 1,2) - Group B: anterior fixation/fusion (Allen stage 3,4) - Group C: combined anterior and posterior fixation/fusion (Allen stage 1,2) - Group D: combined anterior and posterior fixation/fusion (Allen stage 3,4)	- Group A: single-level anterior discectomy or fusion -Group B: posterior cervical fusion	- ACSF - PIWF	-Group A: posterior decompression-ACDF -Group B: anterior facetectomy	-Group A: Posterior decompression -Group B: Combined approach (anterior + posterior decompression)	-Group A: anterior reduction and interbody fusion and fixation -Group B: posterior reduction and short-segmental pedicle screw fixation
Pre-operative parameters								
Frankel score	-Anterior group: 2.2 -Posterior group: 2.3 P > 0.05	Group A: A (8), D (2), E(1) Group B: A (9), D (3), E (1) Group C: A (6), E (1) P > 0.05	N/A	N/A	N/A	N/A	N/A	N/A
ASIA score	- Anterior group: 43 - Posterior group: 40 P > 0.05	N/A	Motoric: A:B ; p = 0.116 A:C ; p = 0.419 B:D;p = 0.109 sensory A:B ; p = 0.127 A:C; p = 0.376 B:D;p = 0.284	N/A	N/A	Group A: 3.32 Group B: 2.77 P > 0.05	N/A	Group A: 3.1 ± 1.1 Group B: 3.2 ± 1.1 P= 0.512
JOA score	N/A	N/A	N/A	N/A	N/A	Group A: 10.38 Group B: 8.17 P > 0.05	N/A	Group A: 9.5 ± 3.6 Group B: 9.6 ± 3.4 P= 0.798

NDI score	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Group A: 29.8 ± 8.2 Group B: 28.6 ± 6.3 P= 0.326
Intra-operative complication	N/A	N/A	N/A	N/A	No complication in both group	N/A	Group A: 1 dural tear Group B: 1 dural tear P=0.52	Group A: 29 Group B: 8 P= 0.004
Surgical time period	N/A	N/A	-Group A: 98.9 ± 18.7 (70–150) -Group B: 98.0 ± 14.1 (80–120) -Group C: 238.0 ± 29.5 (210–280) -Group D: 239.2 ± 30.61 (210–255) P > 0.05	-Group A: 134 min -Group B: 103 min P > 0.05	ACSF: 2.8 h PIWF: 3.6 h P > 0.05	Group A: 274.0 ± 114.7 min Group B: 88.6 ± 35.0 min p = 0.000	Group A: 161.1 min (100–327 min) Group B: Posterior 213.6 min (126–362 min) Anterior 70.2 min (48–110 min) P = 0.16	Group A: 72.1 ± 9.2 Group B: 93.0 ± 11.3 P= 0.000
Estimated blood loss	N/A	N/A	N/A	Both group: < 100 ml	ACSF: 37 ml PIWF: 198 ml P > 0.05	Group A: 275.0 ± 183.2 ml Group B: 92.5 ± 84.0 ml p = 0.000	Group A: 306.38 Group B: Posterior 458.33 ml (100–700 ml) Anterior 122.4 ml (25–337 ml) ml (50–750 ml) P=0.16	Group A: 71.5 ± 14.6 Group B: 102.4 ± 18.5 P= 0.000
Post-operative Parameters								
Frankel score	- Anterior group: 3.1 - Posterior group: 2.3 P > 0.05	Group A: A (6), B (2), E (3) Group B: A (7), B (2), E (4) Group C: A (6), E (1) P > 0.05	N/A	N/A	N/A	N/A	N/A	N/A

ASIA	- Anterior group: 64 - Posterior group: 54 P > 0.05	N/A	Motoric A and B: P = 0.116 A and C: P = 0.419 B and D: P = 0.109 P > 0.05 Sensory A and B: P = 0.127 A and C: P = 0.376 B and D: P = 0.284 P > 0.05	N/A	N/A	Group A: 3.70 Group B: 3.13 P = 0.900	Neurologic improvement (ASIA > 1) Group A: 33.33% Group B 60 % P = 0.57	Group A: 4.6 ± 0.8 Group B: 4.7 ± 0.7 P = 0.631
JOA	N/A	N/A	N/A	N/A	N/A	Group A: 11.75 Group B: 9.37 P = 0.717	N/A	Group A: 14.2 ± 1.6 Group B: 14.4 ± 1.0 P = 0.212
LOS	N/A	N/A	N/A	- group A: 1 – 24 days - group B: 1.5 – 42 days P > 0.05	N/A	N/A	Group A: 13.09±9.39 (3–32) Group B: 16.60±9.02 (8–32) P = 0.09	Group A: 8.6 ± 1.5 Group B: 13.4 ± 2.3 P = 0.000
Pain (VAS)	- Anterior group: 7 - Posterior group: 7 P > 0.05	N/A	N/A	-Group A: 2.1 ± 0.5 -Group B: 3.0 ± 0.4 P > 0.05	ACSF: (-) PIWF: (+) P > 0.05	N/A	N/A	Group A: 3 Group B: 6 P = 0.125
NDI	N/A	N/A	N/A	N/A	ACSF: 5% PIWF: 13%	N/A	N/A	Group A: 7.3 ± 1.7 Group B: 6.7 ± 1.4 P = 0.015
Radiological evaluation	- Anterior group: anterolisthesis neutral - Posterior group: anterolisthesis neutral	N/A	Cobb angle decrease in all group	Sagittal alignment Group A: 5° kyphosis - 20° of lordosis Group B: 11° Lordosis - 19° kyphosis P = 0.0001	N/A	N/A	N/A	Kyphotic angle Group A: -3.5 ± 2.6 Group B: -1.8 ± 2.9 P = 0.000

Fusion rates	- Anterior group: 90% - Posterior group: 100% P > 0.05	Group A: 60.2% Group B: 61% Group C: 6% P > 0.05	Group A: 3.7 ± 2.1 months (range 3–12) Group B: 6.0 ± 2.8 (3–12) Group C: 3.6 ± 1.34 (3–9) Group D: 3.8 ± 2.2 (3–3) P > 0.05	Group A: 100% Group B: 89% P = 0.49	ACSF: 90.9% PIWF: 96% P > 0.05	Both group: 100%	N/A	Group A: 64.4 ± 62.5 Group B: 59.5 ± 57.7 P = 0.515
Re-surgery	N/A	N/A	N/A	N/A	Both group: 0	N/A	Both group: 0 P = 0.99	N/A

* M:F Male: Female; MOI mechanism of injury; MVA motor vehicle accident; ACSF Anterior Cannulated Screw Fixation; PIWF Posterior Instrumentation Without Fusion; ACDF anterior corpectomy discectomy fusion; ASIA American Spinal Cord Injury Association grade; JOA Japanese Orthopedic Association; NDI neck disability index

IV. DISCUSSION

The pertinence of this review is being correlated with a higher prevalence of cervical fractures in our daily practice. The debatable issue regarding cervical fixation approach between anterior and posterior, due to deprivation of evidence based cervical approach comparisons. The incidence of cervical trauma is approximately 150,000 people per year in North America, nearly 15,000 of total cervical trauma is associated with SCI (1 from 25,000 people per year). The higher trend of advanced technology in cervical surgical fixation is not being well paralleled with the expansion of the evidence based consensus nor surgical guidance. For the example, it is commonly being questioned among Orthopedic surgeons; “when is the application of surgical fixation” or “what type of cervical fracture which can be treated with surgical reduction or closed reduction alone”.^{1,2,4,6-9,19,20}

Just about 50 years ago, cervical surgical stabilization has already widely progressed, Smith and Robinson first reported their approach for what they called anterior discectomy and fusion.^{1,7,9} Plating over anterior cervical provides innumerable satisfaction as a complement to ACDF (Anterior Cervical Discectomy and Fusion), it delivers more rigidity to bone fixation, withstand in to bone graft settling and evolution of segmental kyphotic, stimulate more bone’s fusion rates, give less burdensome for external support and help to diminish graft extrusion. On the other hand, anterior cervical plating has some pitfall such as; prolonged surgical time and cost and anterior fixation revision will be more difficult if the anterior plate must be detached. Furthermore, there are some related complication to anterior cervical plating such as esophageal erosion caused by loosening plates and screws, peri-plate ossification in the adjacent segment.^{3,8,21,22,23}

According to Kwon et al, some hypotheses was being provoked from radiological evaluation in respect of comparison between anterior and posterior techniques. From anterior group, there were no case of pseudoarthrosis, while in the posterior group, there were two cases had been found from total of 19 cases. Thoroughly said the difference of fusion rates is 100% for anterior and 89% posterior. In *in vitro* study, for biomechanically aspect in severe unstable cervical spine compared with unilateral facet dislocation model had exemplified that posterior fixation had generally resulted more exceptional than anterior. Johnson and colleagues, outlined that the risk of failure was increasing nearly two third, if flexion-distraction trauma which involved fracture of the endplate were treated with single segment anterior fusion alone. Kwon also stated that a surgeon might face more difficulty to reduce unilateral dislocation with an anterior technique, hence, posterior approach would be preferred to manage the reduction. An annihilating complication for elderly patient associated with anterior technique is the swallowing difficulties which can be susceptible to an aspiration pneumonia.^{2,9,23,24}

The anterior-only technique associated with minimal iatrogenic soft tissue trauma. As well as, the decompression can be done with the direct monitoring to evade the spinal cord trauma. On the authority of Liu et al, this conventional anterior reduction and fixation methods has yielded a two weeks’ reduction rate estimated from 60% to 100%. In contrast, the failure percentage of anterior technique was ranged from 25% to 40% because the constraint of locked joint could not be directly extended by anterior approach only. In the opinion of Oberkircher et al. the determination of anterior reduction stability fully depends on the integrity of facet joint whereas anterior reduction only cannot obtain a sufficient stability particularly in patient with articular process fracture. Nonetheless, posterior technique will be needed for severe posterior column trauma cases to give more stability in posterior column.^{4,17,21,24}

A better outcome has been delineated by previous studies using the posterior techniques. Biomechanical study have provided a superiority of posterior technique compared to anterior and higher stability of the cervical pedicle screw. This approach is mainly acceptable for posterior compression cases of the spinal cord or posterior column injury due to directly reduction and provides more stability. Moreover, Liu et al has analyzed that the prevalence of traumatic disc herniation may be high in cervical facet dislocation cases, estimated from 0.7 to 42%, 29 of 93 patients (31.2%) had been correlated with traumatic disc herniation in Liu's experimental study. It can be concluded that the risk of iatrogenic neurologic deterioration during posterior technique may be increased. The posterior fixation alone cannot do the decompression over disc and ligaments, hence, the anterior fixation may be needed to achieve a good result.^{9,13,17,23,24}

The combination of anterior and posterior technique results a superior outcome than the posterior or anterior fixation alone. This combination technique can provide more stability and adequate decompression as confirmed by previous studies. On the other hand, this combination approach may need a good physical condition of the patient, and this procedure may increase the risk of postoperative infection and iatrogenic trauma in spinal cord because of the greater trauma, prolonged anesthesia and changes of the intraoperative position. In the other opinion, this technique also required a longer surgical time, more blood loss and attach more segment.^{13,14,17,24}

Conclusion

In summary, the successful reduction and fixation may be accomplished by either anterior or posterior approach in variety of cervical trauma combined with spinal cord injury. However, based on the included studies, five studies analyzed that the anterior approach in heterogeneity of cervical injury has been proved to have a higher success rate than posterior approach or combined approach. Other studies investigated that there were no statistically difference between anterior, posterior and combined techniques in cervical trauma. Consequently, the approach selection depends on the surgeon's experience and the cervical fracture involvement.

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