FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE THORACOLUMBAR BURST FRACTURE: OPERATIVE VERSUS CONSERVATIVE TREATMENT

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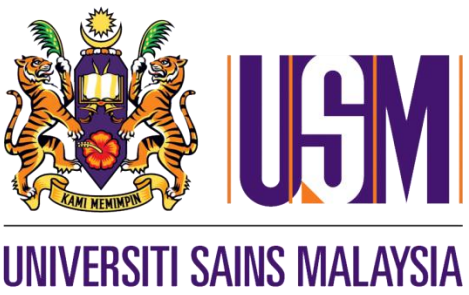

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List of Abbreviations

AO	-	Arbeitsgemeinschaft fur Osteosynthesefragen
ASIA	-	American Spinal Injury Association
AVH	-	Anterior Vertebral Height
CT	-	Computed Tomography
DNA	-	Deoxyribonucleic Acid
HRPZ(II)	-	Hospital Raja Perempuan Zainab (II)
HSNZ	-	Hospital Sultanah Nur Zahirah
HUSM	-	Hospital Universiti Sains Malaysia
MRI	-	Magnetic Resonance Imaging
PACS	-	Picture Archiving and Communication System
PLC	-	Posterior Ligamentous Complex
POP	-	Plaster of Paris
TLICS	-	Thoracolumbar Injury Classification and Severity Score
TLSO	-	Thoracolumbar Sacral Orthosis
VAS	-	Visual Analog Score
VTE	-	Venous Thromboembolism

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ABSTRACT

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE BURST THORACOLUMBAR FRACTURES: CONSERVATIVE VERSUS OPERATIVE TREATMENT

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Introduction

Definitive treatment of unstable thoracolumbar fractures has become controversial in spinal surgery practice. The purpose of this study was to evaluate the short term functional and radiological outcome of unstable thoracolumbar burst fractures treated conservatively and operatively.

Materials and Method

From January 2011 to December 2015, 529 patients with thoracic and lumbar fractures was admitted to our institution. Only 39 patients completed 6 months follow up with complete medical records and radiographs images. Twenty-two (22) single-level unstable thoracolumbar fractures treated conservatively with thoracolumbar orthosis or body cast with early ambulation for 12 weeks and 17 patients treated operatively with posterior

instrumentation and decompression. Retrospectively, we have included the patient who were proposed for operative treatment for spinal instability and neurological deficit but opted for conservative treatment. The ASIA grading, Denis Pain Scale and Denis Work Scale were used to assess the functional outcome and kyphotic angle, anterior vertebral body height were used to assess the radiographic outcome after six months follow up. Statistical analysis done using SPSS ver. 23 and STATA ver.14

Results

Nineteen out of twenty-two patients in conservative group and nine out of seventeen patients in operative group and had intact neurological status. One patient had deterioration of neurological status in conservative group but none in the operative group developed the same complication. In conservative group, one patient (4.5%) and four patients (23.5%) from operative group had improvement of ASIA grading. There were significant differences in kyphotic angle and anterior column height between both groups. However, both groups showed no significant difference of pain status according to Denis Pain Scale with four (18.1%) patients from conservative group and three (17.6%) patients from operative group had no pain while the rest of the patients had mild pain with none of them experienced severe pain and disability. According to Denis Work Scale, 11 (50%) patients from conservative group and 4 (23.5%) patients from operative group returned to previous employment. Two patients from each group were unable to return to full time work. There was no significance difference in between two groups in term of Work Status.

Conclusion

Conservative treatment is an acceptable alternative method to treat unstable thoracolumbar fractures without neurological deficit for those who are not keen for surgical intervention.

Operative stabilization in combination with decompression offer opportunity for neurological recovery.

Keywords

Thoracolumbar fractures, operative, conservative, functional outcome, radiological outcome

ABSTRAK

KEBERKESANAN FUNGSI DAN RADIOLOGI BAGI KECEDERAAN THORACOLUMBAR YANG TIDAK STABIL: RAWATAN SECARA KONSERVATIF DAN PEMBEDAHAN

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PENGENALAN

Rawatan definitif kepatahan *thoracolumbar* yang tidak stabil telah menjadi kontroversi dalam amalan pembedahan tulang belakang. Tujuan kajian ini adalah untuk menilai kesan ke atas fungsi dan radiologi dalam jangka masa pendek akibat kecederaan kepada *thoracolumbar* yang tidak stabil, yang dirawat secara konservatif dan pembedahan.

KAEDAH KAJIAN

Di anatara Januari 2011 sehingga Disember 2015, seramai 529 pesakit dengan keretakan pada tulang thoraks dan lumbar dimasukkan ke institusi kami. Seramai 39 pesakit yang memenuhi rawatan susulan selama enam bulan beserta dengan rekod perubatan dan gambar radiografi yang lengkap. Dua-puluh-dua pesakit dengan kepatahan *thoracolumbar* yang tidak stabil dirawat secara konservatif di mana pesakit boleh bergerak dengan awal menggunakan ortosis thoracolumbar selama 12 minggu. 17 pesakit dirawat melalui pembedahan menggunakan

instrumentasi dan penyahmampatan. Secara retrospektif, kami telah memasukkan pesakit yang dicadangkan untuk menjalani pembedahan kerana ketidakstabilan pada kepatahan tulang belakang beserta keadaan neurologi yang terjejas, namun memilih untuk rawatan tanpa pembedahan. Penggredan ASIA, *Denis Pain Scale* dan *Denis Work Scale* digunakan untuk menilai fungsi pesakit manakala sudut *kyphotic*, ketinggian badan vertebra di bahagian anterior digunakan untuk menilai kesan rawatan secara radiologi, selepas enam bulan rawatan. Analisis statistik dilakukan menggunakan SPSS versi .23 dan STATA versi 14.

KEPUTUSAN KAJIAN

19 daripada 22 pesakit daripada kumpulan konservatif dan 9 daripada 17 pesakit kumpulan pembedahan tidak mengalami sebarang kecederaan pada system neurologi. Seorang pesakit daripada kumpulan konservatif telah mengalami kemerosotan status neurologi di mana tidak berlaku dalam kumpulan yang menjalani pembedahan. Dalam kumpulan konservatif, seorang pesakit (4.5%) dan empat pesakit (23.5%) daripada kumpulan pembedahan mempunyai peningkatan gred ASIA. Sudut *kyphotic* dan ketinggian badan vertebra di bahagian anterior telah menunjukkan kemerosotan dengan ketara manakala dalam kumpulan pembedahan, telah menunjukkan sebaliknya. Kedua-dua kumpulan tidak menunjukkan perbezaan yang ketara dari segi status kesakitan, mengikut skala *Denis Pain Scale* di mana 4 pesakit (18.1%) daripada kumpulan konservatif dan tiga pesakit (17.6%) daripada kumpulan pembedahan tidak mengalami kesakitan, manakala selebihnya mengalami kesakitan yang minimum. Tiada pesakit dilaporkan mengalami kesakitan yang amat teruk sehingga menjejaskan kebolehupayaan. Bagi skala status kerja mengikut *Denis Work Scale*, 11 pesakit (50%) dari kumpulan konservatif dan 4 pesakit (23.5%) daripada kumpulan pembedahan kembali melibatkan diri dalam pekerjaan sebelum kecederaan. Dua pesakit daripada setiap kumpulan tidak dapat bekerja sepenuh masa. Tiada perbezaan yang ketara di antara dua kumpulan dari segi kebolehan kembali bekerja.

KESIMPULAN

Rawatan konservatif adalah kaedah rawatan alternatif yang boleh diterima untuk merawat kepatahan *thoracolumbar* yang tidak stabil bagi pesakit yang tidak mengalami kecederaan neurologi dan pada masa yang sama enggan menjalani pembedahan. Pembedahan untuk menstabilkan tulang belakang apabila digabungkan dengan prosedur penyahmampatan menawarkan peluang untuk pemulihan neurologi berlaku.

KATA KUNCI

Kepatahan thoracolumbar, pembedahan, konservatif, kesan fungsi, kesan radiologi.

CHAPTER 1 : INTRODUCTION

1.1 Problem Statement

Thoracolumbar fractures are comprised of 90% of all spinal fractures, in which 10-20% are burst type fracture.(1, 2) Results from excessive axial loading forces, with or without the element of flexion forces, the burst fracture pattern may associated with neurological deficit and spinal deformity (1). Stability of the spinal column solely depends on integrity of the posterior ligamentous complex, bony column and neural element.(3)

Instability of the thoracolumbar burst fracture characterizes clinically by presence of progressive neurological deficit, worsening of the kyphotic deformity, chronic axial back pain and supported by radiographic evidences such as disruption of the posterior column, retropulsion of the bony fragment and loss of anterior vertebra body height more than 50%.(4)

Aim of managing thoracolumbar fractures are to maximize the function, provide spinal stability, optimizing neurologic function by promotes recovery and prevent deterioration to ensure pain-free lifestyle and almost normal daily function.(5)

At current situation, those with neurological involvement will be treated operatively, leaving the ideal treatment for patient without neurological deficit remains controversial and still debatable. (6, 7)

Very few studies were done to compare the outcome of conservative and operative treatment for burst thoracolumbar fractures in which included those with neurological deficit. In Malaysia, the acceptance of community towards invasive and surgical intervention in treating unstable thoracolumbar burst fractures is still low.

1.2 Justification of the Study

There is limited literature in English language on the study to determine the outcome of unstable burst thoracolumbar fractures treated conservatively and operatively which included patients with and without neurological deficit for some reasons.(8) The purpose of this study was to evaluate the short-term functional and radiological outcome of unstable thoracolumbar burst fractures treated conservatively and operatively. Although the mainstay treatment for those with neurological deficit and unstable thoracolumbar fractures are by surgical spinal stabilization, the fate of the patients who go against the treatment recommendations is something interesting to dig in and explore.

1.3 Benefits of the Study

Thoracolumbar burst fracture accounts for about 20% of the spinal injury. The controversy on method of treatment especially in patients with intact neurology status is still debated. However, the stability of the spine and intractable pain are taken into account when deciding the patient either conservative or operative. Even there were recommended treatment, the patient should be treated individually based on their co-morbid, associated injury, their consent and authorities depends on cultural beliefs and social economic status as spinal surgery and spinal orthosis are costly.

From this study, we can assess the outcome of patient treated based on the recommendations and those not. In orthopaedic field, the patients will always enquire about the prognosis, pros and cons of each treatment, and the risk of not receiving the recommended treatment especially when involving invasive surgery. By doing this study, we also can have objective explanations and evidence to help in our consultation in the future.

CHAPTER 2 : LITERATURE REVIEW

2.1 Thoracolumbar Fracture

Pathoanatomy

Spinal column forms axial skeleton of a human and comprises 29 vertebrae bones; consist of lordotic cervical spine, kyphotic thoracic, lordotic lumbar and 5 fused sacrum. The vertebral body is strong, enough to resist compressive loads, supported by surround ligaments both anterior and posteriorly.(9)

Ligaments also play important roles in providing stability to the spinal column as one unit. Anteriorly, the anterior longitudinal ligament function is to limit the extension of the spinal column while the posterior longitudinal ligament stabilizing the spine during flexion. Both ligaments will fail with tension force or with compression force when in combination with rotation element.(9, 10)

The spinal cord ends either between the disc level of T12/L1 or as low as L2/L3 level. Cone like structures at the end of the spinal cord is called Conus Medullaris and followed by Cauda Equina , a bundle of nerve roots of that innervate the peripheral nervous system of the lower limb.(10)

Biomechanics and Mechanism of Injury

The changing of biomechanical properties at this transitional junction explains the reason for susceptibility of the vertebra spine towards fracture. It is well described that the thoracic segment is more rigid compared to lumbar segment with the presence of thoracic cage. At this junction too, there is a change in sagittal alignment where the kyphotic thoracic segment

change to lordotic lumbar segment and resulted in neutral sagittal alignment in this region. (2, 5, 11)

The concentrated force from hyperflexion and hyperextension injury also contribute to the susceptibility of the junction as the thoracic and lumbar spine have different degree of flexion and extension permitted.(2) The spine may be subjected to four types of fracture patterns which are flexion, flexion and rotation, extension and compression.(12)

Flexion force injury with intact posterior ligamentous complex will result in wedge compression type fractures, which commonly occur in the thoracic and lumbar spines. Fracture-dislocation results from flexion and rotational force. Extension force is a rare injury and commonly occurs in cervical injury. Bursts fractures occur when there is excessive axial loading on the vertebral body causing shattered vertebral body and displacement of the fragments outwards.(13) Bursts fractures characterized by failure of anterior and middle column and typically unstable due to high incidence of neurological deficit due to its canal occlusion by the retropulsed bony and disc fragments.(2, 13)

Instability Concept

The three column concept has been introduced by Denis *et al* (1983) to describe the structures involved in the fracture.(14) Anterior column is consisting of anterior longitudinal ligament, anterior annulus fibrosus and anterior part of vertebral body while the middle column included posterior longitudinal ligament, posterior annulus fibrosus and posterior part of vertebral body.

The posterior column is important for stability of the spine as it depends largely on posterior ligament complex.(5, 12) The complex composed of posterior bony arch anteriorly

and facet joint capsule, intraspinous ligament, supraspinous ligament and ligamentum flavum posteriorly.(13)

Instability of the spine is either mechanical instability, neurological instability or both mechanical and neurological instability. Mechanical instability may lead to progressive kyphotic deformity without neurologic instability and neurologic instability may occur without radiographic findings of mechanical instability.(15)

As the bony elements will heal and unite even in the absence of surgical intervention, the ligaments which act as stabilizer of the spine will not heal, subsequently gave risk of long-term instability. (9, 16)

2.2 Diagnosis

Diagnosis of spinal fractures can easily be missed especially if the patients are under drug or alcohol intoxication, poor conscious level and in multiple injured patients with distracting injuries. Injuries over the spinal column should be suspected in high velocity injuries, altered conscious level, and association with head injuries, pelvis and lower limb injuries as delay in diagnosis will result in increased morbidity and mortality. (13, 17)

Clinical presentation

Advanced Trauma Life Support guidelines should be used during initial assessment of the trauma patients. It is important to keep the patient lies flat until the assessment has been done. Symptoms of numbness, loss of sensation or unable to move the lower limbs is the most common symptoms in conscious patient who sustained neurological deficit. Any bruising or haematoma, palpable step deformity in the spinal column, open wound over the spine, midline spine tenderness, and absence of bulbocavernous reflex, perianal sensation and anal tone from digital rectal examination should raise suspicious of the possibility of spinal injury and must

be done with the patient turn to the side in log rolling manners to prevent further insult to the injured spine and its neural elements.(9, 16, 18) Proper both motor and sensory examination and reflexes should be carried out and documented as it guides the physician which part of the vertebrae involve and determines the treatment and prognosis.(19) The examination findings may be tricky in unconscious patient.(18)

ASIA impairment scale, developed by American Spinal Injury Association (ASIA) is use to document the examination findings and will tell whether the patient had normal, incomplete or complete cord injuries.(20) ASIA A refers to complete injury while ASIA B, C and D represent incomplete injury and ASIA E being as normal neurological status. Incomplete cord injuries will benefit from early surgery and decompression as there is still chance for neural recovery from ischemic state, results from local compression and epidural haematoma.(21) However, in complete cord injuries, the prognosis for recovery is poor and the surgical intervention is mainly to help the patient to move out of bed to facilitate rehabilitation in the future.(19)

Imaging

Plain radiograph is easily available, even in district hospital and less time consuming compared to CT-scan in screening the initial injury. AP view and lateral view will provide information on level affected, morphology of the spine fractures, retropulsed fragments and the degree of displacement.(19, 22) The disadvantage of plain radiographs is possibility to miss the potential injuries if not methodically screened especially fractures of the posterior elements.(17, 23)

Unstable fractures manifest as widening of the interpedicular distance, widening of the interspinous or interlaminar distance, kyphosis deformity more than 20 degrees and loss of vertebra body height more than 50%.(23-25) Some authors recommended 30 degrees

kyphosis as thresholds for surgical treatment as it indicates the failure of posterior ligamentous complex while Petersilge *et al* (1996) find no correlation between the radiographic findings and posterior ligamentous complex injury.(23, 26)

If the plain radiographs cannot provide adequate image to diagnose and detect the abnormality, CT-scan should be done. CT-scan is almost available in all trauma centres and it provides fast image acquisition. The CT-scans can portray information on detail morphology and comminutions of the vertebrae, displacement of the retropulsed fragments, spinal canal diameter compromise, and subtle facet joint injury in both sagittal and axial view.(19, 23, 26). Whenever ligamentous disruption with associated neurologic dysfunction is suspected, magnetic resonance imaging (MRI) is the best modality to determine the extent of soft tissue injuries including spinal cord edema and haematoma, extrusions or bulging intervertebral disc and torn supporting ligaments as part of preoperative planning.(3, 18, 19, 23) The usages of MRI in thoracolumbar fractures have become an increasing trend since the introduction of Thoracolumbar Injury Classification and Severity Score (TLICS). (27)

Neurological Dysfunction

There is no correlation between the spinal canal diameters with the degree of neurological involvement after trauma as radio imaging represent the static canal compromise instead of dynamic trauma process. Many studies have been conducted to investigate these phenomena and reported that the maximum spinal cord compression and spinal canal occlusion occurred during moment of impact, before the fractured bony and disc fragments recoil.(21)

The trauma may subject the spinal cord into 4 types of lesion, either spinal cord concussion, compression, contusion or spinal cord sectioning.(18) Following the initial impact, the ischemic compressed spinal cord together with enzymatic reactions leads to further insult to the spinal cord. Inadequate initial fluid resuscitation, and metabolic acidosis,

hypoperfusion of the inflamed spinal cord will aggravate the lesions, causing the release of more inflammatory mediators and free radicals by macrophage and astrocytes. This cascade of inflammatory response leads to protein oxidation, DNA degradation and subsequently neuronal apoptosis.

Those, stress of spinal cord lesions originate from systemic factors such as hypotension, hypoxia, anaemia, hypothermia, acidosis and glucose imbalance must be treated to reduce extension of the injuries.(18) It is recommended to maintain the mean arterial pressure above 85mmHg for the first week. (18)

2.3 Classification and Scoring

Various classification and scoring system has been introduced to guide the treating physician in managing thoracolumbar fractures especially those without neurological deficit. Most of the classifications are either based on the morphology, neurological involvement, and stability of the spinal column and mechanism of the injury. Some classifications were made to suggest the recommended surgical approach, either posterior only, anterior approach or combined(9).

Denis *et al* (1984) and Holdsworth *et al* (1963) describe the injury of the spine based on column concept and recognized the instability in three degrees, mechanical, neurological instability or both.(12, 15) Other than the three column concept introduced by Denis *et al* (1983), the three degrees of instability arose the importance of biomechanical stability and neurologic compromise in treating the thoracolumbar fractures. First-degree injuries are defined as mechanical disruption either anterior or middle column involvement without threatening the neural elements. The second-degree injuries demonstrate instability of the middle column, which can threatens the neurological deterioration, typically in burst fracture. Fracture-dislocation and severe burst injuries are considered as third-degree injuries as it

threatens both mechanical and neurological elements, which usually required spinal stabilization and decompression.(28)

McCormack *et al* (1994) introduced Load Sharing Classification and proposed that the vertebral fragments of burst fracture do not transfer load as well as the intact vertebra. The classification takes account the comminution of the fractures, displacement and the degree of kyphosis correction needed to restore the physiological normal sagittal alignment.(29, 30) It is used to predict the failure factors of anterior column in short segment posterior only fixation. Thus, McCormack *et al* (1994) concluded that patients with flexion-distraction injures, mild burst fractures or fracture dislocations with score of less than 6 are the best candidates for short segment posterior only fixation. This classification is however not widely used since the evaluation on ligamentous integrity; mechanism of injury and neurological status was not taken into consideration in deciding approach of surgery and treatment plan.(28, 31). AO (Arbeitsgemeinschaft fur Osteosynthesefragen) of Switzerland, via Magerl *et al* published new classification in 1994, where he described the fractures based on morphologic and injuries type into alphanumerical arrangement.(32) It does give some clue on mechanism of the injury and the stability. However, the classification does not influence the decision-making as it does not recognize the neurological status as part of clinical factor that should be taken into consideration while at the same time not practical for day-to-day clinical use.(28)

Later in 2005, Thoracolumbar Injury Classification and Severity Score (TLICS) was introduced by Vaccaro *et al* (2005), based on a survey from a group of worldwide experts in spinal trauma.(33) It helps in identifying the characteristics of injury and the similarities of treatment algorithm for common thoracolumbar injuries. The TLICS scoring need the treating physician to determine the morphology of the injury, the integrity of posterior ligamentous complex by MRI guidance and the neurological status of the patient.(33) The TLICS scoring

is expected to guide the surgeon on choosing the correct approach based on the status of the PLC and neurological involvement.

Patient can be treated conservatively if the severity score is less than 4, indicating stable fractures and treated operatively when the score is more than 5. Whenever the score is equal to 4, the indication for surgery will become less clear and evident.(28, 31, 34) Thus, in 2013, the AO Spine Thoracolumbar Injury Classification system were produced, combination of AO classification by Magerl *et al* and TLICS by Vaccaro *et al*.(35)

2.4 Management

2.4.1 Conservative Treatment

Evolution of Treatment Method

A non-surgical option of treating thoracolumbar fractures is not an option for those with neurological deficit in recent years. Postural reduction, casting and bracing have been the mainstay treatment for stable thoracolumbar junction fractures. Their use in those with unstable burst fractures remains controversial.

Among the earliest reported conservative method for treating thoracolumbar fractures were by Guttmann *et al* (1953) where 774 patients with traumatic paraplegia were treated with immobilization and plaster beds until Holdsworth *et al* (1953) confirmed the disastrous effects of the method such as pressure sore as the main complication.(36, 37)

Frankel *et al* (1969) proposed the use of closed postural in combination with bed rest with the aim of maintaining extension to restore lordotic curve of the segment which needed long hospital stay.(38) Postural reduction and restoration of the sagittal alignment will provide some degree of decompression of the spinal canal while at the same time prevent deformity during the healing process. (38)

In early 80's, Kinoshita *et al* (1993) and Hartman *et al* (1995) recommended their patients by being flat on their bed for 4-8 weeks followed by gradual mobilization supported by bracing up to 6 months duration. Both showed favourable results and outcome achieved with none showed deterioration of neurological status.

Morbidity and mortality rates of the thoracolumbar fracture patients have been improved by promoting early mobilization and immediate ambulation by application of custom moulded thoracolumbar sacral orthosis (TLSO) and bracing for 6 months without the need to stay in bed for weeks.(30, 39-41)

Apart from casting using plaster of Paris (POP), the fiberglass cast is an alternative material available in which results in better radiological outcome hence less pain, more functional for its lightweight and higher satisfaction.(42)

Common orthoses that available for vertebral fracture include 3 point hyperextension brace (Jewett brace), Boston overlap orthoses and Taylor orthoses. Bracing has been associated with reduced hospital stay, provide pain relief by reducing muscle spasm and reducing intradiscal pressure during weight bearing. However, it is not effective on reducing the risk of progressive kyphotic deformity and conversion to surgical treatment in the patient treated conservatively at initial stage.

It is now acknowledged that conservative management is not only by prolonged bed rest and bracing but must be carried out with intensive and aggressive nursing care including physiotherapy, skin care, casting care and its complications, venous thromboembolism (VTE) prevention and rehabilitation process.(16)

Contraindications

Without operative management, the morbidity related to surgical procedure could be avoided. Although many studies showed satisfactory outcome with conservative management, it is not a recommended option for patients with spinal cord or cauda equina syndrome, canal stenosis more than 60%, polytrauma, chest injury which can limit the chest expansion and lungs capacity and obese patient.(43)

Complications

Conservative treatment also comes with complications from either the injury itself, treatment modalities and delay in mobilization.(30, 39, 44-46)

Deep venous thrombosis and pressure sore have been reported by Hartman *et al*.(45) Only few studies did mention the use of anti-coagulant therapy and compression stocking as venous-thromboembolic prophylaxis.(6, 45, 47) Urinary tract infection was the most commonly reported side effect.(30, 39, 40) These were contributed by prolonged immobilization hence the need of bladder catheter.

Complications also arose from mechanical instability such as deterioration of neurological status, conversion of treatment to surgery for axial back pain and progressive kyphotic deformity.(41, 44, 47, 48)

2.4.2 Operative Treatment

About 26-40% of thoracolumbar injury associated with spinal cord trauma results either complete or incomplete neurologic deficit.(49) With the advancement of surgery technique and implant engineering, surgical spinal stabilization offers an alternative treatment to those who opted for early mobilization.(9) It is generally accepted that the management for thoracolumbar fractures with neurological deficit is by surgery with the need of internal

fixation and spinal canal decompression which are advantageous in improving pain, mobilization and rehabilitation and pulmonary function.

After the diagnosis of vertebrae spine fractures were made, the stability of the bony segment and the neurologic component must be evaluated to prevent late deformity or instrumentation failure.

As proposed by White *et al* (1990) the clinical instability is “the loss of the ability of the spine under physiologic loads to maintain its pattern of displacement so that there is no initial or additional neurological deficit, no major deformity and no incapacitating pain.(50) Several systems have been developed to improvise the definition of clinical instability which has been taken into consideration to manage the vertebrae spine fractures which consists of morphology and displacement of the fractures, deformity of the fractures, neurological status, and posterior ligamentous complex integrity, mechanism of the injury, associated injuries and biomechanical properties of the spine. (4)

Indications and Goals of Treatment.

Main indication for surgical intervention in this group of fractures is the presence of spinal segment instability characterizes by significant posterior osteoligamentous complex disruption, which may lead to worsening and progressive loss of normal sagittal alignment, subsequently will compromise the spinal cord and nerve root recovery. Another common reasons for surgical spinal instrumentation is to provide stable spine in patients with incomplete injury, to promote early mobilization and rehabilitation.(51) Those with isolated partial nerve root deficit, operative intervention are usually not necessary as the neurological will recover in months.(7)

The goals of surgical intervention of thoracolumbar fractures are to facilitate the neurologic recovery by decompression of the spinal canal and nerve roots by providing stable spine until biologic fusion occurs.(4) Vertebral body height and alignment can be restore and maintain with rigid fixation while at the same time accelerate ambulation and rehabilitation process. By instrumentation of the vertebrae, the development of post-traumatic deformity and kyphosis can be prevented and it guarantees a better functional outcome.(7)

Thoracolumbar injury with kyphosis more than 20 degrees, subluxation of the posterior facet, increase in interpedicular distance and loss of more than half of anterior vertebra body height with evidence of posterior ligamentous complex disruption will often benefit from surgical stabilization.(52)

Timing of Surgery

Singh *et al* (2004) demonstrated that there are no significant differences in functional neurologic recovery in between groups operatively treated by early and late decompression.(51)

There is still no consensus for early surgery in patients with complete neurology deficit.(18) The need of operative for this group is mainly to provide immediate spinal stability, prevent the need of cumbersome orthosis, promote early ambulation and aids in rehabilitation by reducing time on bed, while preventing decubitus complication (4)

However, in incomplete injury, there are still chances of neurological improvement by one to two grades provided the surgery is done within 24-48 hours. With early surgery and spinal canal decompression, the extension of ischemic spinal cord from the fragment that compressed the neural elements can be limited by preventing further necrosis and apoptosis of the nerve cells, in cases of spinal cord contusion.

Evidence of canal compromise caused by retropulsed bony fragments, soft tissue or an epidural haematoma characterizes by progressive kyphotic deformity and deterioration of neurological deficit are strong indications for urgent surgical intervention.(4)

The associated injuries in polytrauma patients must be taken into consideration when deciding for stabilization of thoracolumbar fractures by operative approach as surgery itself may contraindicate the patient to lie in prone position in cases of solid organs injury such as liver and splenic injury.

Surgical Approach

The aim of surgical treatment can be achieved by means of decompression to reduce the canal pressure on to the neural elements, fracture reduction by correcting the lordosis and regain the acceptable sagittal alignment and stabilization with the use of osteosynthesis in combination with fusion (2, 7) (18)

Indication for anterior approach for stabilization and decompression of the spinal canal by removing the fracture fragments that impinge on the thecal sac from anterior in thoracolumbar fractures has become less and limited compared to posterior approach. It is believed that fracture fragments undergo secondary remodelling which will reduce the spinal canal compromise by 50% where it will be held in place by the posterior longitudinal ligament within two years post trauma.(4, 18, 53)

Posterior approach is the most commonly used in most centers (18, 53, 54) Indirect decompression of the spinal canal through posterior approach is achieved by distraction instrumentation and ligamentotaxis while restoring the sagittal alignment deformity.(16, 18) Following decompression by laminectomy, the spinal stability is further compromised by disrupting the posterior supporting structures and may affect the recovery of the neurologic

elements and risking the patient for further sagittal alignment deformity. Stabilization of the spine with osteosynthesis and fusion are a must.(18)

Neurological recovery in complete cord injuries after spinal decompression has not been shown to significantly improve as compared to stabilization alone. Short segment posterior stabilization has been advocated where the pedicle screw was inserted one vertebra above and one vertebra below.(16) However, this approach was associated with high failure rate, screw pullout and loss of correction if done without reconstruction of anterior column through anterior approach. (16)

In cases of posterior-only surgery, pedicles screws were inserted at two vertebrae above and two vertebrae below with more extensive surgical field.(16)

The use of bracing and orthosis post-operatively has been practiced by many authors to augment the stability of the spine while reducing the pain by minimizing the muscle spasm. (53, 55) The duration of the orthosis or bracing usage can range up to 12 weeks and showed favourable results both radiological and functional outcome.

Complications

Every method comes with complications and so do surgical treatment. In comparison with conservative treatment, surgery has higher rate of infection, hardware failure and subsequent surgery, risk of thromboembolic events and costly. (56).

Venous thromboembolism (VTE) is a serious and fatal postoperative complication. Overall rate of venous thromboembolism in patient who underwent thoracolumbar spinal fusion was 1.90%. A higher rate was noted in patients treated with combined approach compared to anterior only or posterior-only approach (57). Patients who are older, multiple comorbidities and significant weight loss during the illness have higher rate developing VTE

(46). The use of thromboprophylaxis both mechanical and pharmacological agent are varies among surgeons where each of the method may differ in efficacy of preventing VTE. (46)

RESEARCH QUESTION

Does non-operative treatment for thoracolumbar burst fracture carries a comparable outcome with operative treatment?

CHAPTER 3 : OBJECTIVES OF THE STUDY

3.1 General Objective

To compare the functional and radiological outcome of burst thoracolumbar fractures (T10-L2) treated conservative with operative

3.2 Specific Objectives

1. To assess functional outcome of thoracolumbar fractures treated conservative and operative using Denis Work Scale, Denis Pain Scale and ASIA chart progression (in patient with neurological deficit) at 6 months follow up

2. To determine the radiological outcome of thoracolumbar fractures treated conservatively and operative by measuring the Cobbs angle, and anterior vertebral body height compression percentage from radiological findings at 6 months follow up.

3. To compare the functional and radiological outcome in patients with thoracolumbar fractures treated conservative with operative

4. To identify various complications from each method of treatment

CHAPTER 4 : METHODOLOGY

4.1 DESIGN

Retrospective, descriptive study of clinical records was conducted for the study

4.2 SETTING

The study was done in three tertiary centres in the East Coast of Peninsular Malaysia involving Hospital Universiti Sains Malaysia, Hospital Raja Perempuan Zainab II in Kelantan and Hospital Sultanah Nur Zahirah in Terengganu.

4.3 STUDY PERIOD

All the samples were selected from the hospital registry and census obtained from 1st January 2012 to 31st December 2015

4.4 STUDY SAMPLE

All patients who met the inclusion and exclusion criteria within the sampling time frame

4.5 STUDY SUBJECTS

All patients diagnosed as having single level thoracolumbar fractures (T10 to L2) treated conservatively or operatively from January 2012 to 31st December 2015

4.6 PATIENT SELECTION

4.6.1 Inclusion Criteria

a) Patients who have been admitted to all three centres for single level thoracolumbar burst fractures from level T10 to L2

b) Patients' age is 18 years old and above with upper limit of 60 year old

c) The patients had follow up at least 6 months from trauma onset with complete required clinical information and proper plain spine radiographs. The fractured vertebrae must be at the center of the images to enable the accuracy of the measurement.

4.6.2 Exclusion Criteria

a) The patients who had pathological fracture such as spinal metastases and infection either pyogenic or tuberculosis infection

b) Had history of spinal surgery or underlying spinal disease such as degenerative spine disease, prolapsed intervertebral disc and spinal stenosis which require medical treatment.

c) The patient presented with associated injuries involving pelvic bone, multiple lower limbs fracture, cervical and thoracic injury (T1 to T9), and severe head injury

d) The patients who had anterior approach surgery.

e) Incomplete clinical information and plain radiographs (loss of initial film or during follow up, rotated film, inadequate exposure)

4.7 SAMPLE SIZE DETERMINATION

All patients fulfilled the criteria were included in the study.

4.8 SAMPLING METHOD

Convenience sampling method with non-probability sampling was used where all the eligible patients who fulfilled the criteria were taken as study subjects in the study. The number of samples was limited due to availability of the clinical notes and radiographs images. The limitation to get enough samples were face when collecting data in Hospital Raja Perempuan

Zainab II due to massive flood in 2014 which caused most of the clinical notes and plain radiographs ruined and lost.

The diagnosis of burst thoracolumbar fractures is made using proper plain radiographs and CT scans if available and was made by senior spine surgeon in-charge.

4.9 DATA COLLECTION

Data were obtained for all patients who have been admitted from 1st January 2012 to 31st December 2015 for burst thoracolumbar fractures of T10 to L2 level.

Once ethical approved was obtained, patients' medical records were traced using database available in the Medical Record Department of HUSM, HRPPZ (II) and HSNZ using keywords: "thoracolumbar fractures", "Thoracic fractures" and "Lumbar fractures". Cases were also trace from spine census in orthopaedic ward and operation theatres. Only patients who fulfilled the inclusion and exclusion criteria were included.

HUSM is using manual written documentation with computerized radiographs while Hospital Raja Perempuan Zainab II is using manual written documentation and hard copies radiographs. In Hospital Sultanah Nur Zahirah, both clinical case notes and x-rays were recorded in Health Information System (HIS).

Relevant clinical progress and treatment including follow up notes and radio imaging data were collected and organized in pre-designed proforma sheet.

During data collection process, co-investigators were available together with the principal investigator to help tracing, documenting the findings and entering the data.

Co-Investigator in each hospital

1. Dr. Zaraihah binti Mohd Rashid
    - Orthopaedic Medical Officer in Hospital Sultanah Nur Zahirah with 5 years experience in Orthopaedic
2. Dr. Laila Maisarah binti A Rahman
    - Orthopaedic Medical Officer in Hospital Sultanah Nur Zahirah with 3 years experience in Orthopaedic
3. Dr. Mohd Fikri bin Razali
    - Orthopaedic Medical Officer in Hospital Raja Perempuan Zainab (II) with 3 years experience in Orthopaedic

Confirmation of Diagnosis of Burst Thoracolumbar Fractures

Diagnosis of burst thoracolumbar fractures was done using radiographic imaging either plain radiographs or CT scan findings based on this characteristics.(14):

- Increase interpedicular distance from AP view (A focal increase of 2mm compared to average of interpedicular distance of intact above and below vertebrae is suggestive of burst fracture but not specific).(25, 58)
- Loss of anterior vertebral body height more than 50%, involvement of two vertebral columns, with retropulsion of the fragment into the spinal canal.(14)
- posterior element disruption with loss of normal concavity of posterior cortex from lateral view films.

Not all the characteristics must be seen in the plain radiographs.

Thoracolumbar plain radiographs were used to diagnose the fractures. In certain cases where the fractured level was not at the center of the film, repeated radiographs were used

as the main film which usually practice in our centres. If there were no proper film available, the cases were excluded from this study.

The confirmation of diagnosis of burst thoracolumbar fractures were made by the senior consultant in spine-surgery with more than 10 years experience, who were in-charge treating the patients.

Method of Treatment

Conservative Method

The patient was put on bed rest till body cast or TLSO was applied for the next 3 months duration in hyperextension position with immediate ambulation from bed on the next day. Choice of body casts or TLSO were solely depends on the patient's choice.

Operative

Posterior instrumentation involving placement of pedicle screws two levels above and two levels below the fractured vertebra. The decompression procedures by laminectomy were done if the patient had neurological deficit.

Patients that were surgically treated with anterior approach were excluded in this study.

Functional Outcome

ASIA impairment scale, Denis Pain Scale and Denis Work Scale were used to measure functional outcome in selected subjects treated either conservative or operative at initial presentation and after 6-months.

ASIA impairment scale is consists of ASIA A to ASIA E with A represents as complete neurological deficit and E represents intact neurological status.

ASIA status were charted during the initial injury and each time patient came for follow up.

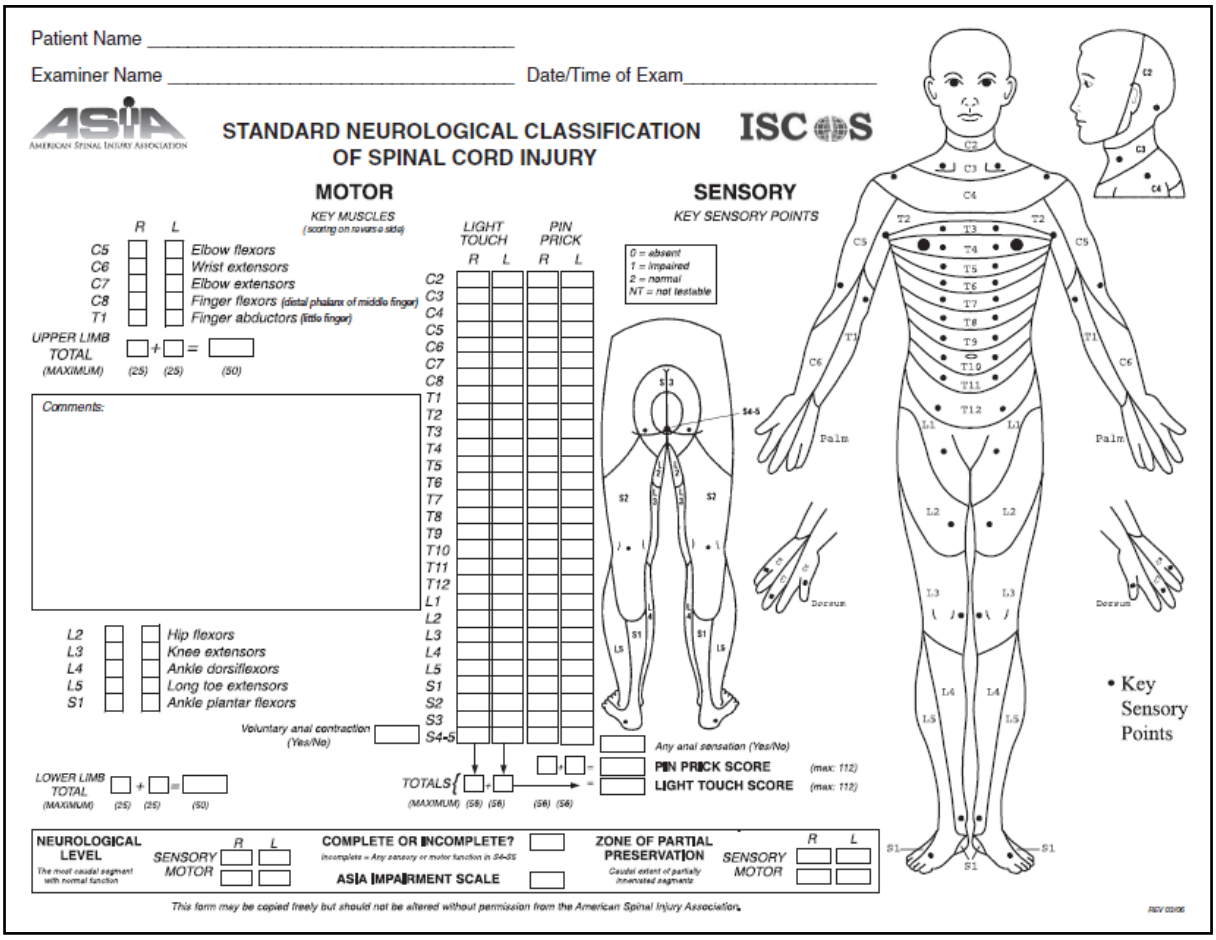

Figure 1 : ASIA Impairment Scale Chart. The chart was developed by American Spinal Injury Association (20)