"Review of Surgical management of Flexion distraction injury of the dorso-lumbar spine"

A dissertation submitted to the Tamil Nadu Dr.M.G.R. Medical University in partial fulfillment of the requirement for the award of M.S. Branch II (Orthopaedic Surgery) degree March 2007-2009

CERTIFICATE

This is to certify that this dissertation titled **““Review of Surgical management of Flexion distraction injury of the dorso-lumbar spine” ”** is a bonafide work done by **Dr. BANDIKALLA VIDYA SAGAR,** in the Department of Orthopaedic Surgery, Christian Medical College and Hospital, Vellore in partial fulfillment of the rules and regulations of the Tamil Nadu Dr. M.G.R. Medical University for the award of M.S. Degree (Branch-II) Orthopaedic Surgery under the supervision and guidance of **Prof. G.D.SUNDARARAJ** during the period of his post-graduate study from March 2007 to February 2009.

This consolidated report presented herein is based on bonafide cases, studied by the candidate himself.

Prof. G.D.SUNARARAJ

D.Orth., M.S.Orth.
M.Ch.Orth.(L'Pool),F.A.CS,F.I.C.S

Professor of Orthopaedics

Department of Orthopaedic Surgery

Christian Medical College & Hospital

Vellore.

CERTIFICATE

This is to certify that this dissertation titled **"Review of Surgical management of Flexion distraction injury of the dorso-lumbar spine""** is a bonafide work done by **Dr. BANDIKALLA VIDYA SAGAR,** in the Department of Orthopaedic Surgery, Christian Medical College and Hospital, Vellore in partial fulfillment of the rules and regulations of the Tamil Nadu Dr. M.G.R. Medical University for the award of M.S. Degree (Branch-II) Orthopaedic Surgery during the period of his post-graduate study from March 2007 to February 2009.

This consolidated report presented herein is based on bonafide cases, studied by the candidate himself.

Prof. Vrisha Madhuri

D.Orth., M.S.Orth., M.Ch.Orth.(L'Pool)

Professor & Head

Department of Orthopaedic Surgery

Christian Medical College & Hospital

Vellore.

ACKNOWLEDGEMENTS

I am deeply indebted to my esteemed teacher , Prof. G. D. Sundararaj, Professor ,Department of Orthopaedics and Accident surgery, Christian Medical College and Hospital,Vellore,Tamil nadu,for his invaluable guidance, unceasing encouragement and constant help.

I am thankful to Head of the Department Prof.Vrisha Madhuri for pemitting me to conduct this study.

I also acknowledge my gratitude to Professor V. N. Lee, Professor Samuel Chittaranjan, Professor Ravi Korula , Assoct. Profs. Vinu M C K.Venkatesh, and Pradeep Punoose and Asst. Profs. Rohit and Anil Oomen for their valuable suggestions.

I thank Mr. Sathish of the Medical Records Department and Mr. Selva raj and Miss Nithya of the Bio-statistics Department for their help when ever needed.

I sincerely thank all the patients who made this study possible and real icons of unflinching nature of Human spirit, May God bless them.

I thank my parents, brothers and my beloved wife Roopa for being there for me always.

Finally I thank the Almighty for enabling me to do this work.

INDEX

10. Annexures

1.INTRODUCTION

Flexion distraction as a mode of mechanism of injury to the dorsolumbar spine has been recognized for many decades. Flexion distraction injuries (FDIs) of the spine result from high- energy forces to the trunk[2-4] . It is usually caused by high-energy trauma such as a, fall from height, RTA, or a sporting accident. The outlook for patients with complete or incomplete thoracolumbar neurological injuries has improved and can be enhanced if an optimum environment for neurological recovery is provided.

The long-term survival and the possibility of functional rehabilitation of patients with spinal cord injuries has led to increased interest in treatment of these patients, the primary treatment of patients with thoracolumbar injuries is surgical reduction, decompression, and stabilization. In the ancient Egyptian papyrus, traumatic quadriplegia and paraplegia was considered a condition not to be treated. Paul of Aegina (AD 625-690) was the first surgeon to do laminectomy for this condition. When the vertebral column injury occurs some degree of neurological deficit is present in significant percentage of cases.

Neurological injury occurs in 40% in the cervical vertebral injury and 15% in thoraco lumbar injury.

This mode of injury has been included in the Denis, McAfee, AO, and TLICS classifications. This fracture is functionally defined by the loss of integrity of posterior column, which acts as the tension band of the spine, which has failed in tension. The posterior vertebral body will also have failed in tension. The anterior column fails in compression because of a flexion force through the anterior column.

Treatment of a solely bony injury with minimal deformity (Chance type) is usually non-operative in an extension brace. The ligamentous rupture and mechanical instability are relative indications to treat these injuries surgically.

The current retrospective study was designed to study the outcome i.e evaluating the radiographic and functional (FIM score) results of the surgical management of the flexion distraction injury of the thoraco-lumbar junction.

2.LITERATURE REVIEW

Thoracolumbar fractures occur from any and all forms of trauma. Twenty percent of them may be associated with neurological deficits.[5,6] Flexion-distraction injuries (FDI) have been recognized as a specific category of thoraco-lumbar (TL) spine injuries since first described by Holdsworth in 1970.[1] The causative trunk bending injury mechanism results in tension failure of the posterior column, whereas anterior column failure is less consistent and may involve elements of both tension and compression.[2-4]

2.1BIOMECHANICS OF THORACOLUMBAR FRACTURES

Denis’s three-column theory of thoraco-lumbar injuries is widely accepted.[7] For flexion–distraction injuries (seat belt–type injuries), he described a failure of the posterior and middle columns under tensile forces generated by flexion with an axis in the anterior column, and a possible partial failure of the anterior column under compression.

However, in most clinical cases, the axis appear to be located in the middle column, because compressive failure of the anterior column is more severe.

2.2 IMAGING

The goals for the radiographic assessment are to accurately demonstrate details of the injuries that have occurred, and to determine if these injuries have compromised the stability of the spine. Standard radiography can accurately document the level of injury and the amount of anterior compression of a vertebral body, fractures of the spinous processes, lamina and transverse processes. CT accurately demonstrated the amount of neural canal encroachment, the posterior element injuries, and the concomitant soft-tissue injuries but was an insufficient method for evaluating the level of injury and the amount of anterior vertebral body compression .[21] Radiographic abnormalities may include a kyphotic deformity with increased vertical distance between the 2 spinous processes, an anterior translational displacement, bilateral subluxation, dislocation, and/or bilateral fracture of the facet joints. [8,9] Integrity of the PLC is categorized as intact, indeterminate, or disrupted. This assessment can be made from plain film, CT, and MR images. It is typically indicated by splaying of the spinous processes (widening of the interspinous space), diastasis of the facet joints, and facet perch or subluxation. Other more indirect measures of posterior ligamentous disruption include vertebral body translation or rotation. When the evidence of disruption is subtle, the integrity of the ligaments is labeled indeterminate. In some cases, clinical examination may be helpful in determining the status of the PLC.[1] For example, a palpable gap between the spinous processes may be evidence that the PLC is disrupted.[11] Unilateral and bilateral facet dislocations of the subaxial spine are associated with damage to numerous soft tissue structures that provide stability to the thoraco-lumbar spine. Bilateral facet dislocations were associated significantly with disruption to the posterior and anterior longitudinal ligaments and left facet capsule, as compared.[12] Another study demonstrated the excellent diagnostic ability of ultrasound to detect the status of the supraspinous and interspinous ligaments, especially in patients who undergo surgery.

Although ultrasound examination appears to be less sensitive than MRI in predicting ligament status, the cost effectiveness of ultrasound and its use as an alternative to MRI in special situations (*i.e.*, patients with pacemaker, ferromagnetic implant, or severe claustrophobia) should be emphasized. The Supra Spinous Ligament, Inter Spinous Ligament, capsules, and LF may be referred to collectively as the posterior ligament complex (PLC). Although the significance of each ligament in maintaining spinal stability has not been investigated thoroughly in terms of the biomechanical aspect, the PLC appears to be important in spinal stability. Ultrasound is emerging as a viable imaging method in the diagnosis and assessment of the musculoskeletal system.[14-17]

2.3 CLASSIFICATION

Classification is the backbone of decision making. Surgical anatomy of Holdsworth two column and Denis three column may be described as basis of the major classification systems. Currently accepted classifications are AO Magerl ABC classification and Thoracolumbar Injury Classification and Severity Score (TLICS)[79].

Load sharing classification should only be used as a complement to the one of the above, since it is applicable for assessment of the degree of anterior column comminution.

It does not identify the severe unstable injuries like distraction injuries (e.g, Magerl Type B, disco-ligamentous injury, or Magerl Type C, three column rotational / translational injuries with minimal vertebral body comminution.

Holdsworth,[18] Denis[19,20] Magerl AO[21], and Load-Sharing [22,23] classifications classify spinal fractures using anatomical and mechanistic principles. They describe a static view of spinal displacement. In 1994, a comprehensive classification scheme known as the AO (Arbeitsgemeinschaft für Osteosynthesefragen) system was introduced by Magerl et al , on the basis of a ten-year review of 1445 thoraco-lumbar injuries. It is based on a progressive scale of increasing morphological damage and morbidity A (compression) B (distraction), and C (rotation) injuries-each of which is divided into three subtypes.

Each of those three sub-types are divided into up to three subgroups, and each of those subgroups divided into up to three subdivisions. Type-A injuries affect only the anterior column, and type-B and type-C injuries affect both the anterior and the posterior column. Thus, severity increases from type A to B to C as well as within the subtypes, subgroups, and subdivisions. It is a very inclusive, albeit complex system.

The AO classification is fairly reproducible. The intra-observer agreement (repeatability) was 82% and 79% for the AO and Denis types, respectively, and 67% and 56%, for the AO and Denis subtypes, respectively.[3]

A new classification system called the Thoraco-lumbar Injury Classification and Severity Score (TLICS)[79] was devised by Vaccaro et.al based on three injury characteristics:

1) Morphology of injury determined by radiographic appearance,
2) Integrity of the posterior ligamentous complex, and
3) Neurologic status of the patient.

A composite injury severity score was calculated from these characteristics stratifying patients into surgical and nonsurgical treatment groups. Finally, a methodology was developed to determine the optimum operative approach for surgical injury patterns.[11]

While the AO classification is based on the mechanism of the severity of the injury , the TLICS classification talks more about the severity and scoring of such injuries. The TLICS classification also provides surgicalguidelines for management of the complex injuries.

Morphology.

A compression fracture is assigned 1 point. If there is a burst component, an additional point (1) is assigned. Translational/rotational mechanism is assigned 3 points. Distraction injuries are assigned 4 points.

Only one morphologic subgroup (compression or burst, translation/ rotation, or distraction) is scored (the highest one) when multiple morphologic features are present. If an injury morphology is unclear, such as with the description distraction when disruption of the PLC is indeterminate, it (distraction) is not listed under the morphology section and therefore not scored. An injury morphology can only be listed if it is clearly thought to be present.

Integrity of the PLC.

An intact posterior soft tissue component is assigned 0 points. Indeterminate disruption is assigned 2 points, while definite disruption is assigned 3 points.

Neurologic Status.

A patient with an intact neurologic examination is assigned no points, while a patient with a nerve root injury is given 2 points. Motor and sensory complete spinal cord injuries are assigned a score of 2 points, while incomplete sensory or motor spinal cord injury or cauda equina injuries are assigned 3 points. A comprehensive severity score of 3 or less suggests a nonoperative injury, while a score of 5 or more suggests that surgical intervention may be considered. Injuries assigned a total score of 4 might be handled conservatively or surgically.

But still the validity of this new TLICS classification system needs to be evaluated. Denis' 3 column theory describes FDI as a failure of the middle and posterior columns under tension, and a possible failure of the anterior column under compression when the flexion force in association with an axis in the anterior column is generated. Mager groups FDI into types B1, B2, and C2 injuries of the Association for Osteosynthesis classification. The main criterion is a transverse disruption of one or both columns. FDI are subdivided into 2 main categories: predominantly ligamentous (B1) and predominantly osseous(B2).[33]

2.4 MODE OF INJURY:

Most of the western studies have showed that the commonest mode of injury is motor vehicle injury.[24,25]But in our study as well as Asian studies it is the fall from height or fall into a well that is the commonest mode of injury in patients sustaining flexion distraction injuries.30-50 % of patients with flexion distraction injuries have associated injuries the majority of which are intra abdominal injuries.[24]

2.5 PRE OP EVALUATION

Proper treatment of patients sustaining spinal injuries involves a meticulously coordinated effort involving emergency response personnel, emergency room physicians, trauma surgeons, orthopaedic surgeons, spine surgeons, anaesthetists, nurses, and rehabilitation physicians and therapists. Polytrauma poses an added challenge to the treatment of patients with spinal injuries.[27,38]

Treatment by Emergency Personnel

The most important aspect of the treatment of the spine injured patient begins at the scene of the accident. The primary goals involve evaluation of the patient at the scene and an understanding of the mechanism of injury.

This is followed by immobilization and extrication from the scene, vehicle, / well and evacuation of the injured to a trauma center. All patients should be assumed to have an injury of the spine until they have been evaluated thoroughly in the admitting area.[33] In all cases of trauma, a cervical collar should be placed before extricating the person from the scene. The patient should be log rolled onto a spine board with manual inline traction to do resuscitative efforts at the scene. Hypovolemic shock initially should be suspected and fluids should be administered. The presence of hypotension without tachycardia could be a reflection of spinal cord injury. Vasopressors should be used only after ruling out hypovolemic shock. Intubation at the scene should be done with strict spine precautions, and the patient should be transferred expediently to a trauma center on a spine board with a rigid cervical collar. The head should be taped to the board with sand bags on either side to prevent rotation.

Initial Evaluation and Resuscitation

Strict spine precautions should be followed while addressing the airway breathing, and circulation. Victims of motor vehicle trauma or falls from heights should be suspected of being in hypovolemic shock secondary to other injuries. The patient should be resuscitated with fluids with judicious use of vasopressors. Maintaining mean arterial pressure greater than 90 mm Hg provides adequate perfusion to the cord to decrease and prevent progressive neurologic injury.

Examination

Approximately 1⁄3 of acute spine injuries are missed.[28]Delayed diagnoses often are associated with head injuries, intoxication, or a patient suffering multiple injuries. In patients with polytrauma, especially when injuries are severe the spinal injury is likely to be missed. Assessment always includes history, physical examination, neurologic examination, and radiologic examination. Initially inspection for signs of direct trauma, ecchymosis, contusion, laceration, and spinal alignment in the sagittal and coronal planes and indirect trauma-associated injury to the head, scapula, pelvis, and long bones is made. Associated injuries should alert the examiner to spinal injury. A study evaluating 508 patients with spine injuries in Canada revealed a 47% rate of associated injuries.[36]Evidence of priapism may suggest a cord injury. A thorough neurologic examination should be done using American Spinal Injury Association guidelines focusing on motor, sensory, and propioceptive levels on arrival to the trauma centre [34]. Neurologic injury can take the form of pain, nerve root injury, partial cord injury or complete cord injury. Partial cord injury syndromes most commonly seen are anterior cord syndrome, central cord syndrome, and Brown-Sequard's syndrome. Cervical and lumbar roots should be examined for sensory and motor functions. Rectalexamination including sensory examination and motor examination to assess S2, S3, and S4 nerve roots always should be done. The spinal reflexes such as the bulbocavernous reflex and anal wink should be documented. Absence of these reflexes associated with hypotonia and areflexia indicates the presence of spinal shock.

Assessment of injury level is unreliable until the resolution of spinal shock. This may take as many as 72 hours. In the patient who is uncooperative or unconscious, examination is limited to inspection, palpation, and assessment of reflexes, and greater caution is exercised in assessment and treatment.

Radiographs

The initial radiographic series should include lateral, antero-posterior, and open-mouth odontoid views of the full cervical and thoraco lumbar spine. This provides sensitivity for detecting a cervical spine injury of approximately 90–95%.[37]

Rotational alignment is assessed based on the relative position of the spine with respect to the spinous processes at each vertebra. Oblique views of the spine may be useful in assessing the facets, foramina, and pedicles, and the vertebral bodies. Lateral and AP views of the thoracic and lumbar spine also should be obtained if there is any clinical suspicion of injury or the patient is uncooperative or unconscious. There also is a 16% incidence of noncontiguous spinal injury necessitating the thorough evaluation of the entire spine when one injury is identified.

When an injury is identified on radiographs, the level of the injury and, at least, the vertebrae above and below the injury should be evaluated with multiplanar CT scans with 3-mm fine cuts. CT with fine cuts and sagittal reconstruction are integral in the diagnosis of injury and preoperative assessment. In the setting of normal plain radiographs and neurologic deficit, Magnetic Resonance Imaging (MRI) examinations are helpful in identifying acute disc herniations or ligamentous injuries. Any progression of neurologic deficit also warrants MRI examination.

2.6 Initial Treatment

Primary neurologic injury at the time of spinal column trauma is mediated through dissipation of energy. Primary injury is associated with cord stress; compression, tension, shear, or disruption. Secondary injury primarily is mediated through alteration in the biochemical environment of the cord and/or through ischemia. However, secondary mechanical injury can occur with failure to stabilize the unstable spine.In the setting of a neurologic deficit, steroids may be administered to the patient immediately, following National Acute Spinal Cord Injury Study III guidelines.[29] If steroids are administered within the first 3 hours of injury, Methylprednisolone should be administered with a 30 mg/kg loading dose followed by a maintenance dose of 5.4 mg/kg/hour for a 24-hour course. A 48-hour course should be given to patients who receive their first dose 3–8 hours after injury.Proton pump inhibitors also should be used for gastrointestinal ulcer prophylaxis.[26]The patient should be moved from the spine board onto a rotating bed as early as possible to prevent decubitus ulcers especially in the insensate patient.

Although early surgical stabilization is desirable and early cord decompression may improve neurologic outcome, the timing of surgery depends on the overall condition of the patient and requires a coordinated treatment strategy deliberated by the entire trauma treatment team before proceeding.

2.7 Spine Trauma Evaluation

Spine injuries can be characterized as soft tissue injuries or fractures. They also can be characterized as stable or unstable injuries. The stable and unstable will refer to mechanical stability with an unstable injury being that in which the spine is unable to maintain a normal structural relationship under physiologic load. Fractures also are categorized according to the mechanism of injury, which often is referred to by the forces applied to the spine. These would include distraction and compression, and flexion and extension, or a combination of these two couples. Examples of combination forces, which can be applied to the spine, include flexion and compression or extension and distraction injuries.

When assessing stability in the spinal column, the three column theory of Denis suggests that if two columns have failed, the spinal column is unstable .[31]In general, this requires failure of the middle column in conjunction with either the anterior or posterior columns. Assessment of the middle column from a radiographic standpoint involves the posterior wall of the vertebral body and posterior longitudinal ligament. Failure of this posterior wall is of concern when radiographic evidence suggests there is widening of the pedicles, there is greater than 25% loss of height of the posterior wall, or there is obvious fracture of the posterior cortex of the vertebral body. Radiographic evidence of disruption of the posterior longitudinal ligament is noted by translation of one vertebral body on the other greater than 3.5 mm or angulation greater than 11°.[32]

Thoracolumbar

The thoracic spine has a natural kyphosis whereas the lumbar spine has a lordotic curve. The thoraco-lumbar junction is at higher risk of fractures because of the change in curvature in the transition zone and the lack of rib cage support. The rib cage provides added stability to the upper thoracic spine making fractures in this region less prevalent. The three-column structural concept of Denis is integral to the evaluation of the thoraco-lumbar spine .[30]It is used in conjunction with the mechanism of injury to predict the injury patterns and stability.[35]Flexion and distraction injuries, frequently described as Chance fractures or seat belt injuries, represent a failure of the middle and posterior columns in tension with the anterior column acting as a hinge. Radiographically, these fractures show widening of the interspinous distance. Injuries through soft tissues tend to heal poorly requiring surgical treatment with a compression construct to recreate the posterior tension band. Bilateral lateral fusions across the site of injury will provide long-term stability. Bony injuries may be treated with a brace and the patient should be followed up meticulously.

Flexion and distraction injuries may be misinterpreted as stable compression fractures with subsequent disastrous cord compromise because of inadequate spinal protection. Fracture dislocations, the fourth type of major injury, are associated with failure of all three columns with a combination of forces including flexion rotation, flexion distraction, or shear.

Neurologic deficit was identified in 75% of patients with this fracture and its subtypes with 52.4% of these being complete.[30]These injuries inherently are unstable almost always requiring definitive surgical stabilization.

2.8 OPERATIVE OR NON OPERATIVE TREATMENT

Over the past few years, operative treatment of unstable flexion distraction spinal fractures has become a standard of practice. Improved techniques and implants provide better surgical outcomes, with decreased morbidity and mortality and improved long-term function.[39-41]Current operative strategies more rapidly return carefully selected patients to work and satisfactory function.[42-45] Hence, patients who cannot be mobilized in a cast or brace within a few days of their injury are often more reasonably treated with surgery. The goals of treatment, operative or otherwise, remain simple:

1. To protect neural elements and maintain/restore neurologic function;
2. To prevent or correct segmental collapse and deformity;
3. To prevent spinal instability and pain;
4. To permit early ambulation and return to function; and
5. To restore normal spinal mechanics.

When unstable thoraco-lumbar fractures disrupt spinal stability, causing pain, deformity, and/or neural injury, segmental instrumentation becomes the key to satisfactory reconstruction and early mobilization.

Among the options for spinal fixation, short and long construct strategies have been developed. Each offers distinct advantages that may serve different situations best.

Nonoperative Treatment

Most patients with flexion distraction injuries will need surgery. The rest can be treated nonoperatively in a brace, molded orthosis, or hyperextension cast, with early mobilization.

Operative Treatment

Operative treatment offers several advantages over casting or recumbency.[47-50] First, immediate spinal stability is provided for patients who cannot tolerate either a cast or prolonged recumbency. In a multiply injured patient, prolonged bed rest predisposes to severe and life threatening complications. Prompt surgical stabilization allows the patient to sit upright, transfer, and start rehabilitation earlier, with fewer complications.[51,52] Second, surgical treatment more reliably restores sagittal alignment, translational deformities, and canal dimensions than does cast treatment. Finally, even though there is insufficient evidence to prove the point, some clinical studies have suggested that surgical decompression more reliably restores neurologic function and decreases rehabilitation time.[50,53-55]

Indications for Surgical Stabilization

Fracture-Dislocations.

Fracture-dislocations result from high-energy trauma (motor vehicle accidents and falls from height) and are often accompanied by neurologic injury and multiple associated injuries.[56,57] Complete spinal cord lesions are not improved by surgery, but mortality and morbidity are both reduced by rapid mobilization and early rehabilitation.

Treatment of Neurologically Intact Patients

In patients with no neurologic injury, treatment decisions are based on mechanical stability and sagittal alignment. Segmental spinal fixation systems allow distraction of specific segments within the construct while neutralizing the overall construct length and sagittal alignment. Posterior instrumentation systems, however, have difficulty resisting sagittal deforming forces when the anterior spinal column is deficient.[58]

Thoracolumbar and lumbar fractures with severe collapse and vertebral comminution will tend to loose correction over time unless anterior instability is corrected. While fixed kyphosis is not significantly associated with a poor outcome, patients with progressive sagittal collapse tend to have more pain and may develop new neurologic symptoms if kyphosis progresses.Residual compromise greater than 50% is worrisome at T12–L1 where the conus medullaris and cauda equina fill the spinal canal. Small increments of progressive axial or sagittal collapse at this level can compromise neurologic elements, and anterior decompression and stabilization should be considered for both mechanical and neurologic purposes.

Treatment of Neurologically Compromised Patients

In patients with neurologic injury, operative treatment is carried out to protect residual function, improve neurologic deficits, and allow early mobilization and rehabilitation without the need for a cast or brace. If the cord or cauda equina injury is incomplete, neurologic decompression can significantly improve the eventual outcome,[53,59,60] assuming there is significant residual compression at the time of surgery. If no residual compression exists, posterior stabilization is carried out alone. If the neurologic injury is complete, posterior instrumentation is usually adequate to allow immediate transfers and early rehabilitation. Anterior decompression has not been demonstrated to improve the changes of neurologic recovery, but anterior reconstruction is helpful in treating sagittal deformity and instability

Mechanics of Thoraco-lumbar Reconstruction

Restoring Sagittal Alignment.

Instrumentation of a spinal fracture provides little benefit unless the spinal alignment is corrected at the time of fixation. The residual deformity in compression, burst, and many dislocation injuries is kyphosis. If this deformity is allowed to persist, it will become fixed and irreducible, but fragments are typically mobile and amenable to indirect reduction immediately after fracture. Persistent deformity at thoraco-lumbar or lumbar levels often produces a fixed kyphosis or a flat-back deformity, leading to pain, dysfunction, and in some cases, implant failure. This complication may necessitate a late revision and reconstruction of the deformed segment. Fractures at the thoraco-lumbar junction T11–L2 are most problematic, since the injured segments are junctional between the rigid thoracic spine and the lumbosacral vertebrae, buttressed by the iliac crests and the heavy lumbosacral ligaments and musculature. Residual deformity at this level is poorly tolerated, and mechanical imbalance predisposes to pain and construct failure. The conus medullaris and cauda equina are also present at this level and at risk of injury. The surgeon can reduce thoracolumbar kyphosis at the time of surgery by carefully positioning the patient in the prone position, with support under the iliac crests and the anterior chest wall, allowing the abdomen and mid-trunk to hang free. This accentuates normal lumbar lordosis, reducing the kyphotic deformity. *In situ* contouring of the fixation rods can restore lordosis to segments that are not completely reduced passively. Gentle distraction may help reduce facet dislocations or sagittal collapse. Implants designed specifically for fracture reduction are available, designed to neutralize construct length at the same time manipulation of the pins corrects sagittal collapse.[61-63] Standard rod-screw or plate-screw constructs can be contoured *in situ* to restore sagittal balance, or the rod can be contoured before placement, then inserted into mono-axial screws and rotated into sagittal orientation to increase lordosis.

Options for Instrumentation: The Long **Versus** *the Short*

The surgeon must chose a construct for the posterior instrumentation, and this decision is made based on the level of the fracture, the pattern of comminution, extent of instability, neural status, as well as the initial decision to reconstruct anteriorly or not. For long segment construct the available option for implant are nonsegmental rod/hook systems (Harrington), Hybrid systems (Luque; Harrington with sublaminar wires), Segmental systems, Rod/hook constructs,Extended pedicle screw constructs.

For short Constructs the available implants are Segmental systems, Short-segment pedicle instrumentation (SSPI), Compression instrumentation. Anterior Screw/Plate or Screw/Rod Instrumentation

Long Fixation Constructs

Successful constructs observe four primary biomechanical principles:

1) Three-point bending forces, applied through the proximal and distal fixation points and the contact of the longitudinal rod with the midthoracic laminae, resist axial and sagittal bending moments trying to create kyphosis.
2) Multiple fixation points distribute corrective forces over a greater number of segments, minimizing risk of pullout failure.

3) Passive or active correction of deformity places the spine in satisfactory sagittal and coronal balance before instrumentation.

4) Anterior column integrity is reestablished for thoracolumbar fractures before loading the posterior instrumentation.

Segmental Fixation Systems

Segmental instrumentation is commonly used for posterior reconstruction of thoracic and thoracolumbar spine fractures. However only a handful of clinical studies have assessed this application.[64-65]The thoracic spine is relatively immobile and tolerant of fusion, and extending the construct into these segments has little mechanical cost, while providing more secure fixation. Pedicle screws allow the surgeon to directly instrument vertebrae with absent or fractured laminae, to provide three-column fixation in unstable injuries, and to limit the length of fusion in the lumbar spine.[66] Combined (or extended) constructs are particularly useful at the thoracolumbar junction

Long (Extended) Fixation Constructs

Extending fusion into the lower lumbar spine does alter segmental mechanics and predisposes patients to junctional pain and subsequent degeneration. Long fixation constructs should terminate at or above the L3 vertebral level to minimize the risk of early degeneration of the L4–L5 and L5–S1 motion segments. Pedicle screw fixation makes this easier.

Extended fixation constructs often incorporate an intermediate hook or screw applied just above the fracture and just below the upper fixation point, and either distracted cranially to generate ligamentotaxis, or compressed caudally to capture and load an anterior strut or cage. With the upper and lower fixation points locked in place to neutralize the overall construct length, this intermediate hook or screw imparts segmental distraction to the fracture to improve vertebral height and indirectly decompress the spinal canal but cannot over distract the spine. While using the same basic reduction strategy as the Harrington rod, segmental rod-hook and rod-screw systems offer unique advantages over first-generation instrumentation systems.[67,68] First, proximal and distal hook-pair(claws) provide more stable fixation than the Harrington hooks they replaced, and they are not dependent on strong distraction forces for fixation. Contact between the rod and the lamina still provides three-point correcting forces in the sagittal plane, but the segmental systems allow placement of intermediate hooks or screws, distributing corrective forces over more laminae and reducing the likelihood of fixation failure.

When hooks are replaced by pedicle screws, fixation strength is further increased and torsional and pullout strength is maximized. In any circumstance, segmental constructs are stiffer than Harrington rods in both axial and torsional loading, allowing the patient to mobilize early, and often without a brace. Extended pedicle screw constructs are intended to address thoraco-lumbar fractures, with as little alteration of lumbar spinal mechanics as possible .

Screws that break after fracture union occurs are often asymptomatic.[128] Bending failure or breakage that occurs before the fracture has consolidated results in progressive material failure and sagittal collapse, and can occur even in braced patients.[43,70] While residual kyphosis has not been associated with pain in some studies, progressive kyphosis and instrumentation failure have been associated with treatment failure and a need for further surgery.[44,58]Patients treated with supplemental offset hooks or with an anterior reconstruction may avoid such segmental collapse.

Short Instrumentation Constructs

While short rod-hook constructs can be effective for flexion distraction injuries and a few other selected fractures,[71] pedicle screws have proven most suited to short segment fixation. Short-segment pedicle instrumentation is the most widely practiced approach now used for thoraco-lumbar and lumbar fractures around the world.

Short-Segment Pedicle Screw Instrumentation (SSPI).

Short segment instrumentation limits the number of segments instrumented to the very minimum necessary to restore sagittal balance and stabilize the fracture. Pedicle screw fixation allows surgeons to stop their fixation constructs in the upper lumbar spine and avoid interference with mid- and lower lumbar motion segments. SSPI rigidly fixes short segments of the thoraco-lumbar spine, providing sagittal, axial, and torsional stability superior to rod/hook constructs or sublaminar wiring.[67,68] An *et al*, in a biomechanical study of L2 burst fractures, found that in short constructs, the fixation provided by pedicle screws is superior in all planes to that provided by hooks, obtaining purchase in all three vertebral columns through a single dorsal approach. They noted no difference in construct stiffness between extended pedicle screw constructs (two-above, two-below) and short-segment pedicle screw constructs. Another advantage to pedicle screws is that fixation does not depend on intact laminae, so there is no need to extend the fusion in cases of laminar fracture or laminectomy. Both the surgical and mechanical disturbance to subjacent lumbar segments is minimized. SSPI has a limited ability to maintain sagittal correction in the face of axial instability, however.If the anterior and middle spinal columns cannot share significant axial loads, the pedicle screw must bear those loads in a cantilever bending mode. The excessive bending moments generated at the screw hub result in a high rate of bending or fracture failure. Once initial bending failure occurs, further collapse is likely, causing progressive loss of lordosis, associated with a higher incidence of clinical failure and pain in some patients.[58]While newer materials appear to have reduced the incidence of bending failure, fracture screws are still seen in titanium screw designs. Augmenting the surgical construct with an anterior strut graft or cage restores the integrity of the anterior column, greatly reducing the cantilever bending forces on the screws . Sagittal alignment is better maintained, and implant failure is greatly reduced.

SSPI at the Thoracolumbar Junction

Ebelke *et al* found that transpedicular bone grafting, performed after manually elevating the fractured endplate and restoring vertebral height, eliminated pedicle screw failure in their series.[72]Similarly, patients with an intact or restored anterior column typically do not experience screw bending failure. While the pedicle screw used in SSPI provides three column fixation within the vertebral body, the SSPI construct cannot, typically, provide three-point bending forces through laminar contact to combat forces trying to create kyphosis. Even if the rod did contact the dorsal lamina of the intermediate vertebral segment, the moment arm between that contact point and the point of screw insertion would be very short and easily overmatched by the long moment arms of the thoracic spine above and lumbopelvic segments below. Instead of countering kyphotic moments through three- point bending forces, SSPI constructs must resist axial and rotation forces through cantilever bending moments, with the axial spine standing on the pedicle screw like a diver on a diving board . Unless the anterior column of the vertebral segment can share some of the axial load, or the construct is extended to share axial and sagittal forces, the unprotected pedicle screw will routinely fail in this environment.

Oda and Panjabi demonstrated that a combination of distraction and hyperextension maneuvers returned a thoraco-lumbar burst fracture to optimal anatomic alignment, while pure compression forces tended to result in greatest stability.[82] Even if the inherent loads of the torso are not enough to damage the screws, loads imparted during instrumentation can create the same problems. *In situ* contouring of the longitudinal rod should not be used to impart significant lordosis unless offset laminar hooks have been applied to supplement screw fixation. These hooks have been shown to improve construct stiffness, reduce screw subsidence, and significantly reduce screw bending moments both in sagittal loading and *in situ* contouring.[69,73] If screws are bent during *in situ* contouring of the fixation rod, they must be replaced. Addition of an anterior strut accomplishes the same goal.

Anterior Reconstruction

Depending on vertebral comminution and neurologic injury, either of these posterior constructs may need to be combined with an anterior procedure. An incomplete neurologic deficit associated with residual compression is a common indication for anterior decompression.

Because functional outcome is more clearly related to the residual neurologic deficit than to any other parameter, surgical decompression remains an all-important aspect of the surgeon's armamentarium.[46,54]

Anterior decompression at the thoraco-lumbar level can be carried out through a combined thoracoabdominal approach, providing access to the entire thoracolumbar segment. After completing the surgical approach, the disc spaces above and below the fracture are excised, and the fractured body removed piecemeal. When the vertebrectomy is completed, the dura should be visible from endplate to endplate, and from pedicle to pedicle. Once the canal is decompressed, the anterior weight-bearing column must be restored. The endplates are prepared for reconstruction, whether with an iliac crest or strut graft, or a fabricated cage.

FUNCTIONAL INDEPENDENCE MEASURE (FIM)

A clear definition of such terms is essential in discussions of morbidity after injury to provide a framework for illustrating the consequence of spinal injury.

Impairment is defined as any loss or abnormality in psychological, physiological, or anatomical structure or function at the level of the organ.

Impairment is coded by the International Classification of Disease (ICD) and can be quantified by the AIS.

Disability is any restriction or lack of ability to perform an activity within the range considered normal.

Disability relates to an individual's behavior and performance of activities for himself.

Handicap is defined as a disadvantage for a given individual resulting from an impairement or a disability that limits or prevents the fulfillment of a role that is normal for that individual in society and as such is a social disadvantage.

Handicap is difficult to measure because it is affected by the individual's psychosocial circumstances and society as a whole. The FIM has been designed as a basic measure of the severity of disability regardless of the underlying impairment. It is based on observed behavior and measures patient's usual ability rather than their best ability. The FIM is unique among systems of functional assessment because it includes communication and social cognition.[83] It has shown validity, reliability, consistency, and precision in measuring disability.[74-76] Therefore, the FIM is a useful tool for assessing disability in patients after trauma. Having limitations resulting from disabilities does not necessarily imply inability to engage in a productive role as defined by work or education. Indeed, a number of post trauma studies have shown a high rate of return to work or education.[75,77-79] The use of FIM scores alone after injury as a predictor of return to employment has been suggested by some authors.The use of FIM scores provides a reliable[74] assessment of tasks that in the main are motor dependent. Because the FIM assessment does not encompass a comprehensive neuro-cognitive assessment, it is not possible to characterize the relation between injury and cognitive deficit.

3. AIM OF THE STUDY

A retrospective analysis of the surgically managed flexion distraction injuries (FDI) of the thoraco-lumbar junction (2000-2006).

4. OBJECTIVES OF THE STUDY

- To determine the role of surgery to reduce, stabilise and maintain the alignment.
- To assess the long-term functional outcome of trauma patients with FDI injury of spine using Functional Independence Measure scores.
- To evaluate TLICS.

5. MATERIALS AND METHODS

A retrospective review of all patients from the Spinal Disorders Unit in the of Department of Orthopaedics, Christian Medical College and Hospital Vellore, diagnosed and operated with flexion distraction injury of thoraco-lumbar junction, over a 7-year period(2000-2006) ,was performed. Institutional review board approval was obtained. The admission radiographs, available CT studies with multiplanar images, were studied .Patients without adequate or available radiographs were excluded from the study. There were 117 spinal injury patients operated in this period .The patients who suffered a Flexion Distraction injury in the thoraco-lumbar spine i.e at T 11,T 12 ,L 1 and L 2, were selected. There were 74 of them, of which 16 patients were treated non-operatively, so excluded from study.40 of the 74 patients with FDI treated operatively were followed-up.

CLASSIFICATION

The classifications we followed were

1. AO (Arbeitsgemeinschaft für Osteosynthesefragen)
2. DENIS
3. TLICS(Thoracolumbar Injury Classification and Severity Score)

TABLE-1 AO CLASSIFICATION DISTRIBUTION

TYPE	FREQUENCY	PERCENTAGE(%)
B1	15	37.5
B2	24	60
C2	1	2.5

TABLE-2 DENIS CLASSIFICATION DISTRIBUTION

TYPE	FREQUENCY	PERCENTAGE(%)
SEAT BELT TYPE- PREDOMINANTLY SOFT TISSUE FAILURE	12	30
SEAT BELT TYPE- PREDOMINANTLY BONY FAILURE	19	47.5
FRACTURE DISLOCATION	9	22.5

Demographic data was collected under the following headings.

AGE: Average age : 33 years(Range : 19-51)

TABLE-3 SEX DISTRIBUTION :

SEX	FREQUENCY	PERCENTAGE(%)
MALE	34	85
FEMALE	6	15

TABLE-4 MODE OF INJURY

MODE OF INJURY	FREQUENCY	PERCENTAGE(%)
FALL FROM HEIGHT	**33**	**82.5**
FALL OF HEAVY OBJECT	**3**	**7.5**
ROAD TRAFFIC ACCIDENT	**4**	**10**

TABLE-5 ASSOCIATED INJURY:

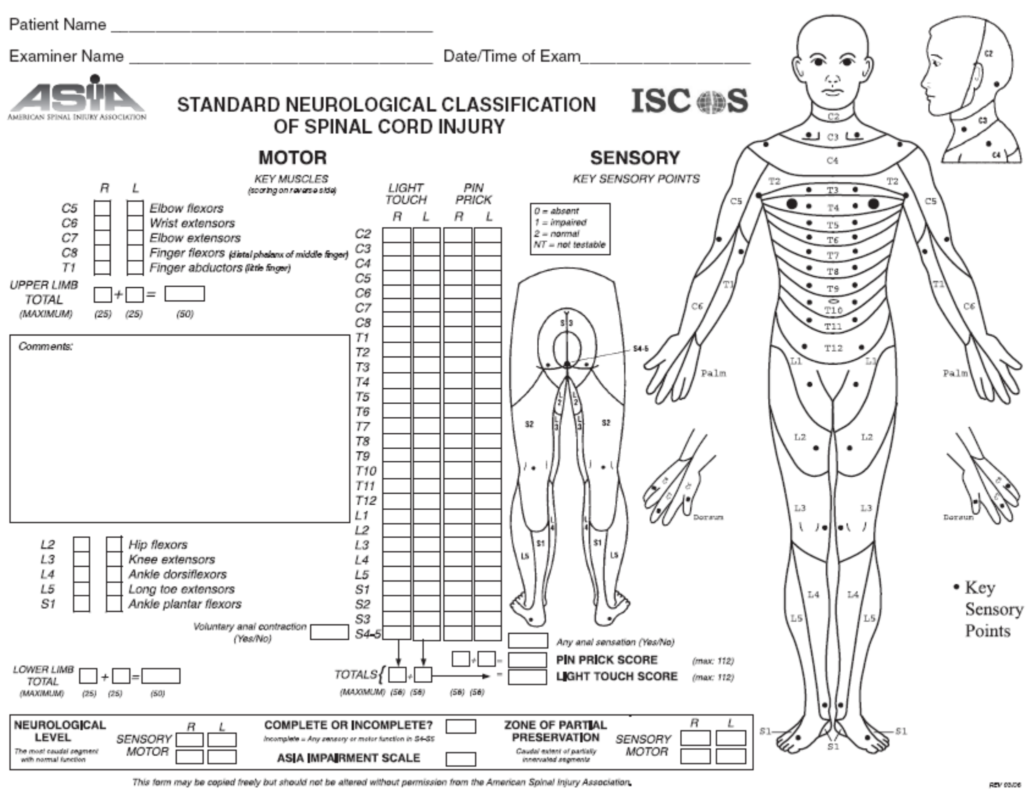
ASSOCITED INJURY	FREQUENCY	PERCENTAGE(%)
LOWER LIMB	5 (calcaneum-3,medial malleoli -1,ankle dislocation-1)	12.5
UPPER LIMB	2 (shoulder dislocation-1,humerus-1)	5
ABDOMINAL	2 (bladder rupture)	5

TABLE-6 LEVEL OF INJURY:

VERTEBRAE	NUMBER	PERCENTAGE(%)
T 11	2	5
T 12	17	42.5
L 1	16	40
L2	5	12.5

NEUROLOGY

The neurological status was assessed by American Spine Injury Association impairement scale as ABCD& E (A-complete loss, B,C& D-Incomplete ,E-intact neurology)



MUSCLE GRADING

0 total paralysis

1 palpable or visible contraction

2 active movement, full range of motion, gravity eliminated

3 active movement, full range of motion, against gravity

4 active movement, full range of motion, against gravity and provides some resistance

5 active movement, full range of motion, against gravity and provides normal resistance

5* muscle able to exert, in examiner's judgement, sufficient resistance to be considered normal if identifiable inhibiting factors were not present

NT not testable. Patient unable to reliably exert effort or muscle unavailable for testing due to factors such as immobilization, pain on effort or contracture.

ASIA IMPAIRMENT SCALE

☐ **A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.

☐ **B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.

☐ **C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.

☐ **D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.

☐ **E = Normal:** Motor and sensory function are normal.

CLINICAL SYNDROMES (OPTIONAL)

☐ Central Cord
☐ Brown-Sequard
☐ Anterior Cord
☐ Conus Medullaris
☐ Cauda Equina

STEPS IN CLASSIFICATION

The following order is recommended in determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
2. Determine motor levels for right and left sides.
   Note: in regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level.
3. Determine the single neurological level.
   This is the lowest segment where motor and sensory function is normal on both sides, and is the most cephalad of the sensory and motor levels determined in steps 1 and 2.
4. Determine whether the injury is Complete or Incomplete (sacral sparing).
   If voluntary anal contraction = **No** *AND all S4-5 sensory scores* = **0** *AND any anal sensation* = **No***, then injury is COMPLETE. Otherwise injury is incomplete.*
5. Determine ASIA Impairment Scale (AIS) Grade:
   Is injury Complete? If **YES**, AIS=A Record ZPP (For ZPP record lowest dermatome or myotome on each side with some (non-zero score) preservation)
   NO ↓
   Is injury motor incomplete? If NO, AIS=B (Yes=voluntary anal contraction OR motor function more than three levels below the motor level on a given side.)
   YES ↓
   Are at least half of the key muscles below the (single) neurological level graded 3 or better?
   NO ↓ AIS=C   YES ↓ AIS=D

If sensation and motor function is normal in all segments, AIS=E
Note: AIS E is used in follow up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.

FUNCTIONAL INDEPENDENCE MEASURE SCORES (FIM)

The outcome was quantified using FIM scores, which are based on a patient's ability to routinely perform certain tasks in 18 activities of daily living. Each item is graded numerically on a scale of 1 (total dependence) to 7 (independence). There are scores for both cognitive and motor functions. Therefore, a minimum FIM of 18 implies total dependence, and a maximum FIM of 126 implies no disability. Each patient was assessed by a physician and a multidisciplinary team composed of occupational therapists, physiotherapists, social workers, and nurses during the inpatient hospital stay. However, during follow-up evaluation, assessments for FIM scores were made by direct examination. The functional activity (*i.e.,* ability to dress) was described and explained to the patient. This was followed by a list of options regarding level of independence in performing each of the activities. The patient was asked to make a single selection that best described his or her status. Functional Independence Measure scores were obtained at three intervals i.e At the time of hospital discharge, and then subsequently at the end of Rehabilation and at the final follow-up. All patients were put through a programme of rehabilitation under Physical Medicine and Rehabilitattion department

Functional Independence Measure

Classification	Item
Self-care	Eating
	Grooming
	Bathing
	Dressing—upper body
	Dressing—lower body
	Toileting
Sphincter control	Bladder management
	Bowel management
Mobility	Bed, chair, wheelchair
	Toilet
	Tub, Shower
Locomotion	Walk or wheelchair
	Stairs
Communication	Comprehension
	Expression
Social cognition	Social interaction
	Problem solving
	Memory

Scoring Scale for Each Task

Degree of Dependency	Level of functioning	Score
No helper	Complete independence	7
	Modified independence	6
Modified dependence on a helper	Supervision	5
	Minimal assist (at least 75% independence)	4
	Moderate assist (at least 50% independence)	3
Complete dependence on a helper	Maximal assist (at least 25% independence)	2
	Total assist (less than 25% independence)	1

RADIOLOGICAL PARAMETERES

Antero-osterior (AP) and cross-table lateral radiographs were independently assessed, as were transaxial and sagittal CT images, with a prepared check list. The sagittal kyphosis and translation are noted to quantify the deformity. (ANNEXURE-1) Surgical notes were reviewed. Patients were called in for review. During the follow-up they were assessed for neurological improvement, bowel and bladder management. Any complaints like backache, decubitus ulcers, and urinary tract infections are noted. X-rays are taken at every follow-up. (standard antero-posterior and lateral radiographs)

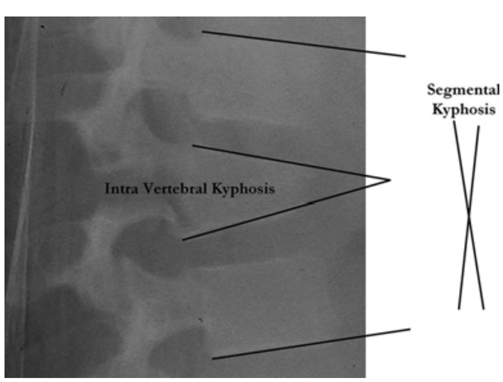
1.ANTERO-POSTERIOR TRANSLATION :

In case of antero-posterior translation is measured on the lateral radiograph. A vertical line along the posterior border of the upper and lower vertebra is drawn and the distance between the vertical lines was measured using the GE digital radiography software.

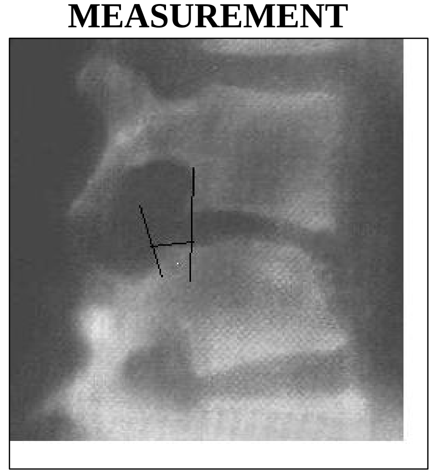
2. SEGMENTAL KYPHOSIS:

Segmental kyphosis was determined from the superior endplate of the vertebra cephalad to the fractured vertebra and the inferior endplate of the vertebra caudad to the fracture. All angle measurements were obtained after the radiographs were digitalized.

KYPHOSIS MEASUREMENT



TRANSALATION MEASUREMENT



SURGICAL TREATMENT

All cases had operative fracture reduction, realignment with posterior stabilization by pedicle screws and using either plate (STEFFE) or rod. Fixation in the vertebra was either one level (one vertebra above and one vertebra below) or two level (two vertebra above and two vertebra below).

INDICATIONS FOR SURGERY

1. Mechanical instability.
2. Incomplete neurological deficit.
3. Poly-trauma

Three types of surgeries were performed.

1. Posterior instrumentation and correction of kyphotic and translational deformity only
2. Dual column surgery

a. Posterior instrumentation and anterior column reconstruction (combined)

b. Extended posterior surgery In posterior only surgery the anterior column was not reconstructed.

In extended posterior surgery anterior column was reconstructed through posterior approach .

In combined surgery the anterior column was reconstructed through anterior approach.

TABLE – 7 TYPE OF SURGERY

TYPE OF SUGERY	FREQUENCY	PERCENTAGE(%)
POSTERIOR ALONE	4	10
EXTENDED POSTEIOR	12	30
POSTERIOR+ANTERIOR	24	60

TABLE-8 NO OF COLUMN FIXED

COLUMNS FIXED	FREQUENCY	PERCENTAGE(%)
POSTERIOR COLUMN ALONE	4	10
DUAL COLUMN(POSTERIOR+ANTERIOR)	36	90

ANTERIOR COLUMN RECONSTRUCTION

Anterior column was reconstructed using either Tricortical Iliac Crest bone grafting or Titanium mesh with morcellised cancellous graft. In three cases no anterior column reconstruction was done.

TABLE-9 ANTERIOR COLUMN RECONSTRUCTION

ANT.COLUMN RECONSTRUCTION	FREQUENCY	PERCENTAGE(%)
TRICORTICAL ILIAC CREST BONE GRAFT	29	72.5
TITANIUM MESH WITH GRAFT	7	17.5
NO RECONSTRUCTTION	4	10

Parameters studied at the time of follow-up are

1. Clinical parameters
2. Radiological parameters

CLINICAL PARAMETERS

1. ASIA Impairment grade,
2. Functional Independance Measure,
3. Complaints

RADIOLOGICAL PARAMETERS

1. Level of injury
2. Classification(AO,Denis,TLICS)
3. Translation
4. Segmental kyphosis
5. Implant integrity
6. Union

SURGICAL PARAMETERS

1. Type of surgery
2. Implants used.
3. Posterior level of fixation

6. RESULTS

6.1 DEMOGRAPHY

40 patients had adequate follow-up. Thirty-four males (85%) and six females (15%) were evaluated. The mean age for the study group was 32.9 years, ranging from 19 to 51 years. The mechanism of injury was fall in 33 (82.5%); struck by a falling object in 3 (7.5%); and motor vehicle accident in 4 (10%).Most of the patients were manual labourers (87.5%) and injury is related to work(coconut/palm tree climbing).In 31 of them the spinal injury is isolated 77.5%.In patients who had associated injury the lower limb injury is common.(calcaneum-3,medial malleoli -1,ankle dislocation-1).

6.2 FRACURE:

All patients had AP and lateral radiographs (pre op/post op and follow-up) of the thoraco-lumbar spine. The distribution of the Thoraco-lumbar fracture i.e D11-L2 fractures is outlined in Table.

TABLE-6 LEVEL OF INJURY:

VERTEBRAE	NUMBER	PERCENTAGE(%)
T 11	2	5
T 12	17	42.5
L 1	16	40
L2	5	12.5

Among the injured vertebrae , the individual vertebral involvement is as follows,(16)40% at L1, (17) 42.5% at D12 ,(5) 12.5 % at L2 and (2) 5 % at D11. On AP radiographs, increased interspinous distance was seen in all patients, which is indicative of the flexion-distraction mechanism of injury. A transverse fracture through the pedicles was seen in 76%,

Other radiographic signs supporting the diagnosis of flexion-distraction injury included horizontally oriented fractures across the transverse processes, laminae, and articular processes. Lateral radiographs showed fanning or distraction of the spinous processes, indicative of a hyperflexion mechanism.

6.3 CLASSIFICATIONS

AO and DENNIS classifications are used to classify these 40 patients. According to **AO** classification Group B2, predominantly osseous posterior flexion-distraction injury; 92.5% (37) . Group B1, predominantly ligamentous posterior flexion-distraction injury, 5%(2). Group C2, type B injury with rotation; 2.5%(1) .

DENNIS

Seat-belt-type injuries

1.With fracture line predominantly through the Soft tissue in the middle column-30 %(12)

2.With fracture line predominantly through the Bone in the middle column-47.6%(19) and

3.Fracture dislocations are 22.5% (9)

ASIA GRADING

ASIA IMPAIRMENT SCALE

A = Complete: -------- 60% (24)

B = Incomplete: ------ 5% (2)

C = Incomplete:------- 15% (6)

D = Incomplete:------- 2.5% (1)

E = Normal: ----------- 17.5% (7)

At the final follow-up ASIA Impairement scale 18 people comprising 45 % had no recovery and 15 % showed improved by at least one grade to full recovery(table-10)

TABLE-10 NEUROLOGICAL RECOVERY

NEUROLOGICAL IMPROVEMENT	NUMBER	PERCENTAGE(%)
NO RECOVERY	18	54.5
PARTIAL RECOVERY	6	18.2
COMPLETE RECOVERY	9	27.3
TOTAL NEROLOGICALLY IMPAIRED	33	100

TABLE-11 NEUROLOGICAL GRADE CHANGES

	PRE-OP	FOLLOW-OP
A	24	18
B	2	0
C	6	3
D	1	3
E	7	16
TOTAL	40	40

TABLE 12 NEUROLOGICAL GRADE CHANGES

GRADE	FINAL ASIA-A	B	C	D	E	TOTAL
PRE OP ASIA- A	18	0	2	2	2	24
B	0	0	1	1	0	2
C	0	0	0	0	6	6
D	0	0	0	0	1	1
E	0	0	0	0	7	7
T0TAL	18	0	3	3	16	TOTAL

NEUROLOGICAL GRADE CHANGES

	A	C	D	E
A – 24	18	2	2	2
B – 2		1	1	
C – 6				6
D -1				1
E – 7				7

TABLE -13 The FIM for individual ASIA groups was analysed

ASIA-A	POST OP	FOLLOW UP
NUMBER	24	18
MEAN	81.76923	102.2308

The test of significance for ASIA-A shows significance P<0.001.

TABLE-14 FIM SCORE

FIM	MEAN
POST-OP	65.2
POST-REHAB	87.7
FINAL FOLLOW-UP	102

TABLE-15 FIM vs ASIA IMPAIREMENT GRADING

	POST-OP FIM(MEAN)	POST REHAB FIM(MEAN)	FINAL FOLLOW-UP FIM(MEAN)
ASIA - A+B+C(32)	53.7	77.5	95.6
ASIA-D+E (8)	71.4	87.6	105.9

The test of significance for ASIA-(A +B + C) and (D+E) and FIM scores shows significance P<0.001.

RADIOLOGICAL PARAMETERES—DEFORMITY TRANSLATION

Translation more than 5 mm is considered significant as quoted by many authors. The pre operative average translation is 3.2 mm.post op mean translation is one (1).Which is statistically significant when put through the t-test where the P-value is 0.001.No loss is noted in the corrected sagittal translation

TABLE-16 TRANSLATION

	PRE-OP(mm)	POST-OP(mm)	FOLLOW-UP(mm0	LOSS IN CORRECTION(mm)
TRANSLATION	3.2	1	1	0

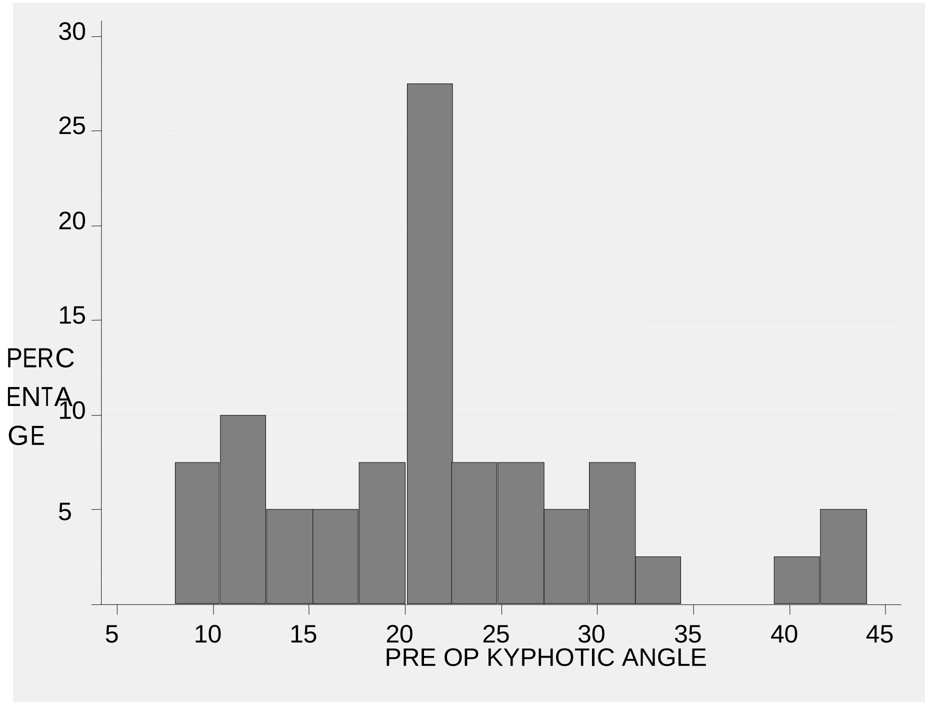
KYPPHOTIC DEFORMITY:

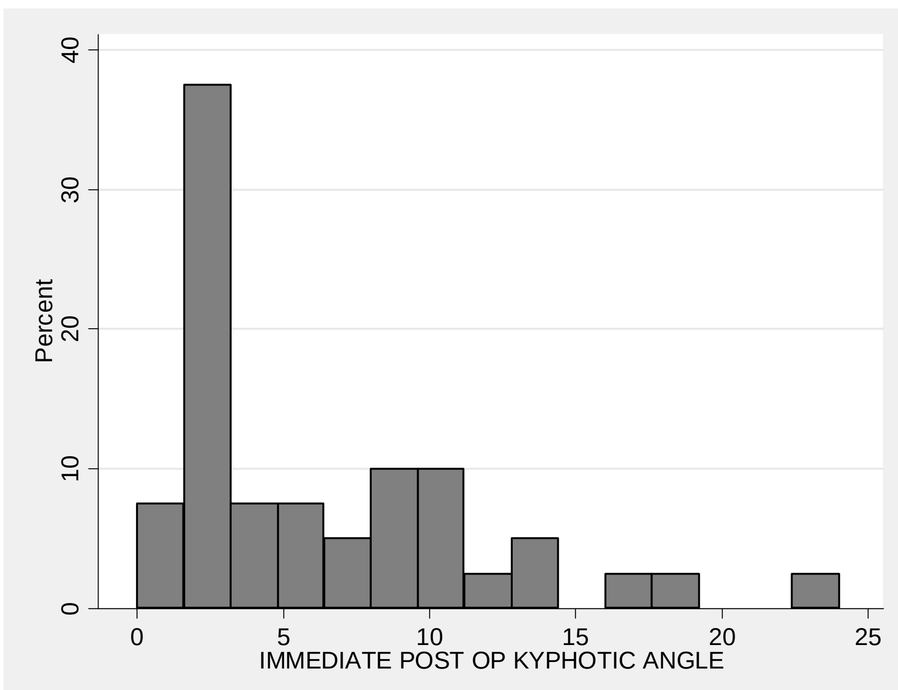
Kyphosis is measured as the angle subtended between a line along the upper end plate of the upper normal vertebrae and another line along the lower end plate of the lower normal vertebrae.(Cobb)

The kyphotic angles are showed in the table below. Pre op the mean Kyphotic angle noted is 22^0, the same in the post is 6.4^0 and in the follow up it is 8^0.The t-test shows statistically significant difference in the preop and post op kyphotic angle levels.

TABLE-17 KYPHOSIS

KYPHOSIS	**MEAN**
PRE-OP	$21.9^0(8^0\text{-}44^0)$
POST-OP	6.4^0
FOLLOW-UP	7.9^0


30
25
20
15
PERCENTAGE
10
5
5 10 15 20 25 30 35 40 45
PRE OP KYPHOTIC ANGLE


40
30
Percent
20
10
0
0 5 10 15 20 25
IMMEDIATE POST OP KYPHOTIC ANGLE

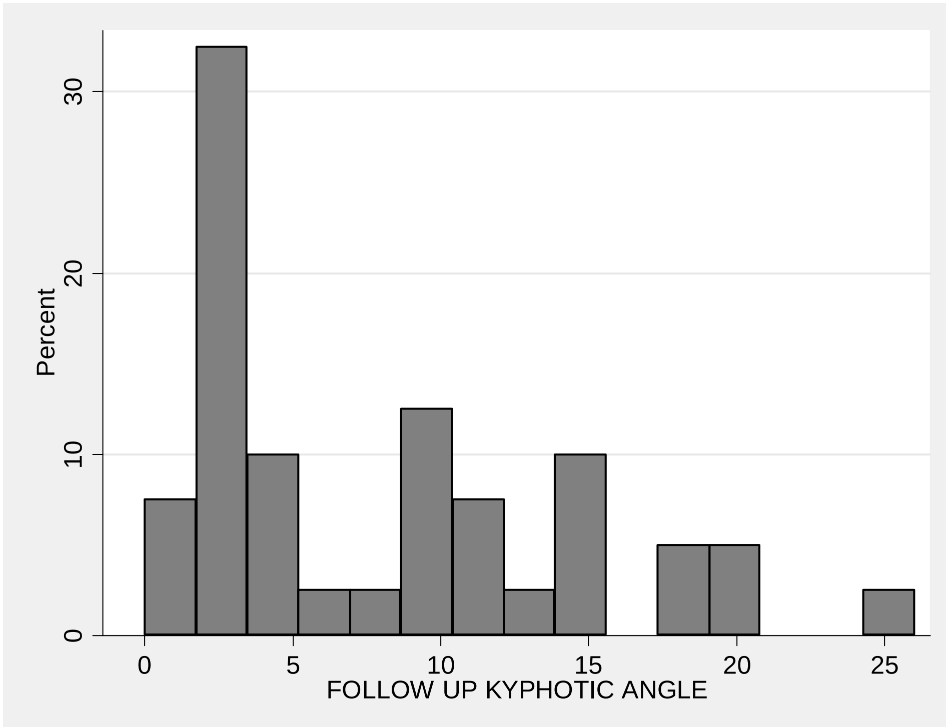


TABLE-18 PRE-OP KYPHOSIS ANGLE

MEAN	22^0
RANGE	8^0-44^0
$<5^0$	0
6^0-10^0	3
10^0-20^0	17(42%)
$>20^0$	20(50%)

TABLE-19 POST-OP KYPHOSIS ANGLES

MEAN	6.4^0
RANGE	0^0-24^0
<5^0	23(57.5%)
6^0-10^0	9(22.5%)
10^0-20^0	7(17.5%
>20^0	1

TABLE-20 FOLLOW-UP KPHOSIS ANGLE

MEAN	7.9^0
RANGE	0^0-26^0
<5^0	20(50%)
6^0-10^0	7
10^0-20^0	12(30%)
>20^0	1

TABLE-21 SURGERY AND KYPHOSIS

TYPE OF SURGERY	PRE-OP	POST-OP	FOLLOW-UP	LOSS IN CORRECTION
SINGLE COLUMN SURGERY				
POSTERIOR	14.8^0	5.3^0	8^0	2.7^0
DUAL COLUMN SURGERY				
EXTENDED POSTERIOR	23.5^0	7.2^0	9.6^0	2.4^0
POSTERO-ANTERIOR	22.3^0	6.1^0	7^0	0.9^0

TABLE-22 SURGERY AND TRANSLATION

TYPE OF SURGERY	PRE-OP(mm)	POST-OP(mm)	FOLLOW-UP-LOSS IN CORRECTION(mm)
SINGLE COLUMN SURGERY			
POSTERIOR ONLY	1	0	0
DUAL COLUMN SURGERY			
EXTENDED POSTERIOR	7	1	0
POSTERIOR+ANTERIOR	1.6	1	0
OVERALL MEAN	3.2	1	0

TABLE-23 TLICS CLASSIFICATION AND TYPE OF SURGERY

	TLICS-7	TLICS-9	TLICS-10
POSTERIOR ONLY	2	1	1
EXTENDED POSTERIOR	0	10	2
POSTERIOR+ ANTERIOR	5	13	6

TABLE-24 COMPLICATIONS

COMPLAINT/COMPLICATION	NUMBER	PERCENTAGE(%)
BACKACHE	9	22
DECUBITUS ULCER	5 (sacral sores-2/trochanteric sores-2/heel-1)	12.5
IMPLANT FAILURE	1	2.5
DONOR SITE INFECTION(PSIS)	1	2.5

7.DISCUSSION

The overall results of operative treatment of flexion distraction injuries of the dorso-lumbar spine studied in this dissertation have been good with good restoration of spinal anatomy, acceptable loss of Cobb angle and translation. Also there has been good union of the factures and only insignificant pain at follow-up.

The mechanism of injury is the shifting of the fulcrum of the force in the middle column , forward bending of the trunk, thus producing distraction in the posterior column and compression in the anterior column of the spine[4-6]. Most of our patients are in the age group between 20-40 yrs -69%, and most of them are coconut tree climbers. Unlike other studies our study population has fall from height as the commonest mode of injury i.e-82.5%.[84]Males are predominantly affected -34/40-(85%.)

Unlike Chance fracture most of our patients,[20] 78.5% did not have associated injuries and among the associated injuries the malleolar fractures are common , as the injury involves direct landing on feet from a height.[7-9]The mean follow-up is 37 months (13 – 90).

Clinically many patients had a contusion and deformity at the fracture level with palpable inter-spinous gap. Because flexion distraction injuries are tri-column injuries most of the patients will have spinal cord injury (SCI) as well. In this study 87.5% patients have either complete (60%) or partial (22.5%) SCI.

A detailed evaluation of the neurological system was done, and the examination was repeated after about 72 hr to look for reflexes after the spinal shock wears off .ASIA impairement scale is the standard in grading the patients neurologically. In our study, like other studies[2,3] large number of patients neurologically were ASIA-A i.e 24 patients comprising 60%,incomplete injury noticed in 22.5% of patients,7 patients (17.5%) had no neurological impairement.

Radiographic findings are subtle in patients with soft tissue disruptions alone.

Indirectly the posterior column distraction was made out with the increased interspinous distance. The associated fractures of the posterior elements like transverse split of the spinous processes are also noted. The middle column may fail either in distraction or compression based on the axis of force, if it is anterior to the middle column, middle column will fail in distraction and vice versa. The middle column failure can be divided in to either predominantly soft tissue or predominantly bony. If it is through bone union will be good, if the fracture line is through the soft tissue the union will be a problem.

The anterior column always fail in compression, resulting in a kyphotic deformity. In very severe injuries there may be subluxation or dislocation of the facet joints resulting in the forward translation of the vertebra, and finally the most devastating injury will be dislocation with rotation component noted on the x-ray with respect to spinous processes. Based on the radiographs and ct scans fractures were classified based on AO, DENIS and TLICS classifications. According to AO flexion distraction injuries are classified under group B1, B2,& C2 .In our study predominant group is B2 with 24(60%) patients, followed by B1 15(37.5%) patients and one patient with associated rotation injury C2.(TABLE-1)

According to Denis classification 31 patients had seat belt type injuries of them predominantly bony involvement of posterior column is noted in 19(47.5%), soft tissue in 12 patients (30%) and 9 (22.5%) patients had dislocation of the facet joints .(TABLE-2)

According to TLICS our operative group of patients had scores, 7-10. Patients with score 10 were with incomplete neurological deficit and those with 9 were having complete neurological deficit,those with score 7 were having no neurological deficit at all.(TABLE-23)

Treatment of a flexion distraction injury of thoraco-lumbar spine fracture depends not only on the severity of injury but also on the fracture pattern. When a fracture line passes through the bone, immobilization with extension cast or brace provides good healing and recovery. Our patients who were treated non operatively all had predominantly bony injury and TLICS score of 7, kyphotic angle is less than 12^0 and non of them had any neurological deficit (not included in study),the follow-up kyphotic angle is 16^0, and there was no translation noted. Surgery is indicated for significant soft tissue (ligamentous) injury or bony injury with displaced fractures. We continue to base our decision to operate on information obtained from a detailed history, careful clinical examination, and imaging studies like radiographs and CT scans. Patients who have sustained high energy injuries, those with evidence of major posterior soft tissue injury, neurologic deterioration, clinical instability, a severe initial kyphosis, usually , and patients with multiple injuries are candidates for operative stabilization.[39-41]

Three different kinds of surgery are being done. 24 patients (60%) underwent posterior instrumentation followed by anterior column reconstruction, cord decompression, and canal clearance .

In the extended posterior surgery after posterior pedicle screw fixation , through laminectomy the anterior column is reconstructed,12 patients(60%) underwent the same, and all of them had 2 level fixation as we are approaching anterior column through posterior laminectomy ,so for further stabilization another level of fixation is recommended.

In posterior alone surgey only posterior instrumentation was done no anterior column was reconstructed,all these patients had no neurological deficit and had TLICS score of 7 and pre-opkyphosis deformity of 14.8^0. post –op kyphosis5.3^0 and at the follow-up kyphosis was 8^0 so the loss in kyphosis correction is 2.7^0 .The translation is 1mm,0mm,and 0mm,pre-op,post-op and follow-up respectively. In principle dual column surgery can be performed through a double approach (posterior followed by anterior) or through a single extended posterior approach. Both aim at posterior instrumentation, stabilization and anterior column reconstruction and restoration. Hence the indications for both these forms of surgery are nearly the same. The choice of operation may vary with the neurological condition of the patient and the experience of the surgeon. Generally we have performed extended posterior posterior surgery in cases of total complete paraplegia with sever injury to the cord. In cases where there is incomplete paraplegia we have tried to avoid this approach. This is because the extended posterior approach involves retraction and handling of the dura and its contents. In such cases we preferred posterior followed by anterior. The extended posterior surgery is technically demanding as it involves reconstruction of the anterior column through the posterior approach. It must also be noted that extended posterior approach ivolves greater destabilization as we perform a laminectomy and costo-transversectomy as part of this procedure.

In the dual column surgeries i.e Extended posterior and Combined posterior and anterior surgeries TLICS scores ranged from 9-10.The

Kyphoti angles for extended posterior approach are 23.5 ^{0}, 7.2 ^{0}, 9.6 ^{0} –at pre, post-op and follow-up respectively. The loss in kyphosis correction is 2.4 ^{0} . The pre-op translation was 7 mm ,post op was 1 mm and at the time of follow up there is no loss in translation correction.

In combined posterior and anterior group the pre-op translation was 22.3 ^{0} ,post was 6.1 ^{0} and at the time of follow-up it was 7 ^{0} .The loss in correction was 0.9 ^{0} .Pre-op translation was 1.6 mm,post was 1mm and there was no loss in translation correction at the time of follow-up.

Surgery always consists of posterior instrumentation one or two levels above and the injured level. Regarding level of fixation we preferred single level fixation above and below the fractured vertebrae, predominantly i.e 27 (67.5%) patients and rest of the patients who had double fixation are 13(32.5%) .

Additional anterior column reconstruction is planned when indicated. Anterior column reconstruction was done in 36 patients using either tricortical iliac crest graft, in 30 (75%) patients or titanium mesh with morcellised bone graft in 7(17.5%) patients . At the time of final follow-up all patients who underwent anterior column reconstruction united.

The kyphosis was measured in all patients pre, post –opand at the time of final follow-up with GE –PathSpeed Web 8.1 software. The mean of the pre-op kyphosis is $22^{0}(8^{0}-44^{0})$,post –op kyphosis is $6.4^{0}(0^{0}$-

24^0).At the time of follow-up the mean kyphosis is 7.9^0(0^0-26^0) with gain in kyphosis 1.5^0 which is comparable to other studies.

KYPHOSIS	**Our study**	**Knop[83] et al.**	**Esss[63] post**	**Sam abraham j et.al[85]**	**Abe eiji et.al[84]**
PRE-OP	22^0	15.6^0	28.9^0	19.6^0	27^0
POST-OP	6.4^0	$.54^0$	18.7^0	5.7^0	8^0
FOLLOW-UP	7.9^0	10.1^0	9.3^0	8^0	12^0
LOSS IN CORRECTION	1.5^0	10.5^0	9.4^0	2.3^0	4^0

The mean of translation pre-op is 3.2mm (0-20) and the mean of post –op translation is 1 mm (0-8mm) .There is no loss of corrected translation at the time of follow-up (0mm).

There was one patient who had more than $20^{\ 0}$ 0f kyphosis pre,post and at the time of follow-up. She underwent combined, posterior followed by anterior surgery, single level fixation was done posteriorly and anterior column reconstruction was done by using titanium mesh with bone graft. She sustained fracture dislocation with circumferential loss of continuity.

When chi-square test was done with regard to loss of kyphosis correction and different type of surgery, statistically no signifince is noted.

The aim of dorso lumbar spinal injury has been early ambulation without brace whenever possible. When surgery is planed the objective of surgery include restoration of alignment and sagittal balance permitting early ambulation in a brace.

The FIM scores were measured for all the patients at the time of discharge from the first admission, after 3 months of rehabilitation and at the time of follow-up.

There is a steady increase in the FIM in all patients. The mean post-op FIM-65(48-67), post rehabilitation it is 87 and at the time of final follow-up the FIM is 102.

When t-test was done for the post-op FIM and post rehab FIM it is highly significant ($p<0.001$). Similarly the t-test is highly significant ($p<0.001$) when it is between post rehabilitation and at the time of final follow-up. The t-test between post –op and follow-up FIM of ASIA –A,B & C and D&E group it is highly significant.($p<0.001$)

There is significant neurological recovery is noted. All incomplete patients those who are in grade, C and D all recovered completely. Of 2 patients in B-grade one improved to C-grade and the other one to D-grade. Of the 24 patients in A grade initially 18 patients had no recovery and 6 patients recoverd to C, D, and E grade (2each).

At the time of final follow-up 9 patients complained of back ache which is mainly on prolonged sitting, which is relieved by rest. Decubitus ulcer is seen in five patients around sacrum in two patients, the greater trochanter in two patients and heel sore in one patient. One patient had implant failure and he underwent implant exit. One patient had chronic infection of the Posterior Superior Iliac Spine donor site, which healed after removal of the bonewax.

Most of the patients who have not recovered bowel and bladder function are doing self intermittent catheterization and digital evacuation of the stools and also using stool softeners like isopgol granules and Bisacodyl suppositories. Some of them had urinary tract infections but patients promptly reported to the Physical Medicine and Rehabilitation Department for the treatment as they were sensitized to recognize UTI early.

LIMITATIONS OF THE STUDY

1. There is no uniformity in sampling as it is a retrospective study**.**
2. There is no control group to compare with so compared with other similar studies.

8.CONCLUSIONS

1. The Operative stabilization when indicated allows early rehabilitation in flexion distraction injury of dorso-lumbar spine.
2. The choice of surgery depends on the severity of the injury. Posterior stabilization alone is adequate in some cases(when the TLICS score is 7).Dual column surgery is indicated in more severe injuries.(When the score is 8-10)
3. Kyphosis and translation correction achieved at surgery are well maintained at the follow-up of an average,3 years.
4. Complications relating to surgery are few and far outweigh the complications of treatment in recumbency.
5. Early rehabilitation and ambulation results in significant improvement in the functional independence of the patient.
6. TLICS has a scoring system which guides the surgeon when considering operative treatment of flexion –distraction injures.How ever our study does not support the cut off point of 4 for non operative treatment in these injuries.

9. REFERENCES

1 Holdsworth F. Fractures, dislocations, and fracture-dislocations of the spine. *J Bone Joint Surg Am* 1970;52:1534–51.

2 Hoshikawa T, Tanaka Y, Kokubun S, et al. Flexion-distraction injuries in the thoracolumbar spine: an in vitro study of the relation between flexion angle and the motion axis of fracture. *J Spinal Disord Tech* 2002;15:139–43.

3 Neumann P, Nordwall A, Osvalder AL. Traumatic instability of the lumbar spine. A dynamic in vitro study of flexion-distraction injury. *Spine* 1995;20: 1111–21.

4 Neumann P, Osvalder AL, Nordwall A, et al. The mechanism of initial flexion-distraction injury in the lumbar spine. *Spine* 1992;17:1083–90.

5 Kewalramani LS, Taylor RG. Multiple Non-Contiguous Injuries to the Spine. Acta Orthop Scand 1976;47:52–8.

6 Henderson RL, Reid DC, Saboe LA. Multiple Noncontiguous Spine Fractures. Spine 1991;16:128–31.

7 Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine* 1983;8: 817–31.

8 Magerl F, Aebi M, Gertzbein SD, et al. A comprehensive classification of thoracic and lumbar injuries. Eur Spine J. 1994;3: 184–201.

9 Anderson PA, Henley MB, Rivara FP, et al. Flexion distraction and chance injuries to the thoracolumbar spine. J Orthop Trauma. 1991; 5:153–160.

10 Radiographic Evaluation of Thoracolumbar Fractures JAMES S. KEENE, M.D.* Clinical Orthopeedics and Rdated Researc Number 189 October. 1984

11 11 .A New Classification of Thoracolumbar Injuries The Importance of Injury Morphology, the Integrity of the Posterior Ligamentous

Complex, and Neurologic Status Alexander R. Vaccaro, MD,* et al SPINE Volume 30, Number 20, pp 2325–2333,2005.

12 Magnetic Resonance Imaging Analysis of Soft Tissue Disruption After Flexion-Distraction Injuries of the Subaxial Cervical Spine Alexander R. Vaccaro, MD,*et.al SPINE Volume 26, Number 17, pp 1866–1872

13 Feasibility of Ultrasound Examination in Posterior Ligament Complex Injury of Thoracolumbar Spine Fracture Seong-Hwan Moon, MD,et al SPINE Volume 27, Number 19, pp 2154–2158

14 Friedman L, Finlay K, Jurriaans E. Ultrasound of the knee. Skeletal Radiol 2001;30:361–77.

15 Georgy BA, Hesselink JR.MRimaging of the spine: Recent advances in pulse sequences and special techniques. AJR Am J Roentgenol 1994;162:923–34.

16 Goldberg AL, Rothfus WE, Deeb ZL, et al. The impact of magnetic resonance on the diagnostic evaluation of acute cervicothoracic spinal trauma. Skeletal Raiol 1988;17:89–95.

17 Goodwin DW. Imaging of the Achilles' tendon. Foot Ankle Clin 2000;5: 135–48. 30. Middleton WD, Teefey SA, Yamaguchi K, et al. Sonography of the shoulder. Semin Musculoskelet Radiol 1998;2:211–22.

18 Holdsworth F. Fractures, Dislocations, and Fracture-Dislocations of the Spine. J Bone Joint Surg Am 1970;52:1534–51.

19 Denis F. Spinal Instability As Defined by the Three-Column Spine Concept in Acute Spinal Trauma. Clin Orthop 1984;189:65–76.

20 Denis F. The Three Column Spine and Its Significance in the Classification of Acute Thoracolumbar Spinal Injuries. Spine 1983;8:817–31.

21 Magerl F, Aebi M, Gertzbein SD, Harms J, Nazarian S. A Comprehensive Classification of Thoracic and Lumbar Injuries. Eur Spine J 1994;3:184–201.

22 McCormack T, Karaikovic E, Gaines RW. The Load Sharing Classification of Spine Fractures. Spine 1994;19:1741–4.

23 Parker JW, Lane JR, Karaikovic EE, Gaines RW. Successful Short-Segment Instrumentation and Fusion for Thoracolumbar Spine Fractures: a Consecutive 41/2-Year Series. Spine 2000;25:1157–70.

24 Thoracolumbar Flexion-Distraction Injuries Associated Morbidity and Neurological Outcomes Jens R. Chapman, MD,et.al SPINE Volume 33, Number 6, pp 648–657,2008

25 Outcome Analysis of Chance Fractures of the Skeletally Immature Spine Kishore Mulpuri, MBBS, MS(ortho)et.al, SPINE Volume 32, Number 24, pp E702–E707,2007

26 Albert TJ, Levine MJ, Balderston RA, et al: Gastrointestinal complications in spinal cord injury. Spine 16(Suppl):522–525, 1991.

27 American College of Surgeons Committee on Trauma: Initial Assessment. In Advanced Life Support Student Manual. Chicago, American College of Surgeons 21–46, 1997.

28. Bohlman HH: Acute fractures and dislocations of the cervical spine: An analysis of three hundred hospitalized patients and review of literature. J Bone Joint Surg 61A:1119–1142, 1979.

28 Bracken MB, Shepard MJ, Holford TR, et al: Administration of methylprednisolone for 24 to 48 hours or tirilazad mesylate for 48 hours in the treatment of acute spinal cord injury: Results of Third National Acute Spinal Cord Injury Randomized Control Trial: National Spinal Cord Injury Study. JAMA 277:1597–1604, 1997.

29 Denis F: The three-column spine and its significance in the classification of acute thoracolumbar spinal injuries. Spine 8:817–831, 1983.

30 Denis F: Spinal instability as defined by the three-column spine concept in a acute spinal trauma. Clin Orthop 189:65–76, 1984.

31 De Klerk LW, Fontjine WP, Stijnen T, et al: Spontaneous remodeling of the spinal canal after conservative management of thoracolumbar burst fractures. Spine 23:1057–1060, 1998.

32 Huelke DF, O'Day J, Mendelsohn RA: Cervical spine injuries suffered in automobile crashes. J Neurosurg 54:316–322, 1981.

33 Maynard FM: The International Standards for Neurological and Functional Classification of Spinal Cord Injury. Chicago, American Spinal Injury Association 1–26, 1996.

34 McCullen G, Vaccaro AR, Garfin SR: Thoracic and lumbar trauma: Rationale for selecting the appropriate fusion technique. Orthop Clin North Am 29:813–828, 1998.

35 Saboe LA, Reid DC, Davis LA, et al: Spine trauma and associated injuries. Trauma 31:43–48, 1991.

36 Vaccaro AR, An HS, Lin SS, et al: Noncontiguous injuries of the spine. J Spinal Disord 5:320–329, 1992.

37 Vaccaro AR, Blam OG: Adult Spine Trauma. In Koval KJ (ed). Orthopaedic Knowledge Update 7. Rosemont, IL, American Academy of Orthopaedic Surgeons 693–607, 2002.

38 Aebi M, Etter C, Kehl T, et al. The internal skeletal fixation system: a new treatment of thoracolumbar fractures and other spinal disorders. *Clin Orthop* 1988;227:30–43.

39 Bohlman HH, Freehafer A, Dejak J. The results of treatment of acute injuries of the upper thoracic spine with paralysis. *J Bone Joint Surg Am* 1985;67: 360–9.

40 Bosch A, Stauffer ES, Nickel VL. Incomplete traumatic quadriplegia: a tenyear review. *JAMA* 1971;216:473–8.

41 Bohlman HH. Treatment of fractures and dislocations of the thoracic and lumbar spine. *J Bone Joint Surg Am* 1985;67:165–9.

42 Carl AL, Tromanhauser SG, Roger DJ. Pedicle screw instrumentation for thoracolumbar burst fractures and fracture-dislocations. *Spine* 1992; 17(suppl 8):317–24.

43 McLain RF, Benson DR, Burkus K. Segmental instrumentation for thoracic and thoracolumbar fractures: prospective analysis of construct survival and five year follow-up. *Spine J* 2001;1:310–23.

44 Willen J, Lindahl S, Nordwall A. Unstable thoracolumbar fractures: a comparative clinical study of conservative treatment and Harrington instrumentation. *Spine* 1985;10:111–22.

45 Bone LB. Management of polytrauma. In: Chapman MW, ed. *Operative Orthopaedics*, 2nd ed. Philadelphia: Lippincott, 1993.

46 Broom MJ, Jacobs RR. Current status of internal fixation of thoracolumbar fractures. *J Orthop Trauma* 1989;3:148–55.

47 Dickson JH, Harrington PR, Erwin WD. Results of reduction and stabili-zation of the severely fractured thoracic and lumbar spine. *J Bone Join Surg Am* 1978;60:799 – 805.

48 Gaines RW, Humphreys WG. A plea for judgement in management of thoracolumbar fractures and fracture-dislocations. *Clin Orthop* 1984;189:36–42.

49 Jacobs RR, Asher MA, Snider RK. Thoracolumbar spinal injuries: a comparative study of recumbent and operative treatment in 100 patients. *Spine* 1980;5:463–77.

50 Dickman CA, Yahiro MA, Lu HT, et al. Surgical treatment alternatives for fixation of unstable fractures of the thoracic and lumbar spine: a metaanalysis. *Spine* 1994;19(suppl 20):2266–73.

51 Fletcher DJ, Taddonio RF, Byrne DW, et al. Incidence of acute care complications in vertebral column fracture patients with and without spinal cord injury. *Spine* 1995;20:1136–46.

52 Bradford DS, McBride GG. Surgical management of thoracolumbar spine fractures with incomplete neurologic deficits. *Clin Orthop* 1987;218:201–16.

53 Clohisy JC, Akbarnia BA, Bucholz RD, et al. Neurologic recovery associated with anterior decompression of spine fractures at the thoracolumbar junction (T12–L1). *Spine* 1992;17(suppl 8):325–30.

54 Osebold WR, Weinstein SL, Sprague BL. Thoracolumbar spine fractures: results of treatment. *Spine* 1981;6:13–34.

55 McEvoy RD, Bradford DS. The management of burst fractures of the thoracic and lumbar spine: experience in 53 patients. *Spine* 1985;10:631 -7.

56 Place HM, Donaldson DH, Brown CW, et al. Stabilization of thoracic spine fractures resulting in complete paraplegia: a long-term retrospective analysis. *Spine* 1994;19:1726–30.

57 McLain RF, Sparling E, Benson DR. Early failure of short segment pedicle instrumentation for thoracolumbar fractures. *J Bone Joint Surg Am* 1993; 75:162–7.

58 Dimar JR 2nd, Wilde PH, Glassman SD, et al. Thoracolumbar burst fractures treated with combined anterior and posterior surgery. *Am J Orthop* 1996;25:159–65.

59 McAfee PC, Bohlman HH, Yuan HA. Anterior decompression of traumatic thoracolumbar fractures with incomplete neurological deficits using a retroperitoneal approach. *J Bone Joint Surg Am* 1985;67:89–104.

60 Benson DR, Burkus JK, Montesano PX, et al. Unstable thoracolumbar and lumbar burst fractures treated with the AO fixateur interne. *J Spinal Disord* 1992;5:335–43.

61 Dick W. The fixateur interne as a versatile implant for spine surgery. *Spine* 1987;12:882–900.

62 Esses SI, Botsford DJ, Wright T, et al. Operative treatment of spinal fractures with the AO internal fixator. *Spine* 1991;16(suppl 3):146 – 50.

63 Graziano GP. Cotrel-Dubousset hook and screw combination for spine fractures. *J Spinal Disord* 1993;6:380–5. 119. McBride GG. Cotrel-Dubousset rods in spinal fractures. *Paraplegia* 1989; 27:440–9.

64 Stambough JL. Cotrel-Dubousset instrumentation and thoracolumbar spine trauma: a review of 55 cases. *J Spine Disord* 1994;7:461–9.

65 Gurr KR, McAfee PC, Shih C. Biomechanical analysis of anterior and posterior instrumentation systems after corpectomy: a calf-spine model. *J Bone Joint Surg Am* 1988;70:1182–91.

66 Farcy J-P, Weidenbaum M, Michelsen CB, et al. A comparative biomechanical study of spinal fixation using Cotrel-Dubousset instrumentation. *Spine* 1987;12:877–81.

67 Gurr KR, McAfee PC, Shih C. Biomechanical analysis of posterior instrumentation systems after decompressive laminectomy: an unstable calf-spine model. *J Bone Joint Surg Am* 1988;70:680–91.

68 Chiba M, McLain RF, Yerby SA, et al. Short-segment pedicle instrumentation: biomechanical analysis of supplemental hook fixation. *Spine* 1996;21: 288–94.

69 Kramer DL, Rodgers WB, Mansfield FL. Transpedicular instrumentation and short-segment fusion of thoracolumbar fractures: a prospective study using a single instrumentation system. *J Orthop Trauma* 1995;9:499–506.

70 Benzel EC. Short-segment compression instrumentation for selected thoracic and lumbar spine fractures: the short-rod/two-claw technique. *J Neurosurg* 1993;79:335–40.

71 Ebelke DK, Asher MA, Neff JR, et al. Survivorship analysis of VSP spine instrumentation in the treatment of thoracolumbar and lumbar burst fractures. *Spine* 1991;16(suppl):428 –92.

72 Yerby S, Ehteshami J, McLain RF. Offset laminar hooks decrease bending moments on pedicle screws during in-situ contouring. *Spine* 1997;22:376–81.

73 Emhoff TA, McCarthy M, Cushman M, et al. Functional scoring of multitrauma patients: Who ends up where? J Trauma 1991;31:1227–32.

74 Gerhart KA. Spinal cord injury outcomes in a population-based sample. J Trauma 1991;31:1529–35.

75 Hamilton BB, Laughlin JA, Fiedler RC, et al. Inter-rater reliability of the 7-level functional independence measure (FIM) [see comments]. Scand J Rehabil Med 1994;26:115–9.

76 Kivioja AH, Myllynen PJ, Rokkanen PU. Is the treatment of the most severe multiply injured patients worth the effort? A follow-up examination 5 to 20 years after severe multiple injury. J Trauma 1990;30:480–3.

77 MacKenzie EJ, Siegel JH, Shapiro S, et al. Functional recovery and medical costs of trauma: An analysis by type and severity of injury. J Trauma 1988; 28:281–97.

78 Rhodes M, Aronson J, Moerkirk G, et al. Quality of life after the trauma center. J Trauma 1988;28:931–8.

79 80.A New Classification of Thoracolumbar Injuries The Importance of Injury Morphology, the Integrity of the Posterior Ligamentous Complex, and Neurologic Status Alexander R. Vaccaro, MD,et al SPINE Volume 30, Number 20, pp 2325–2333

80 Assessment of Two Thoraco lumbar Fracture Classification Systems as Used by Multiple Surgeons Kirkham B. Wood, et.al *J Bone Joint Surg Am.* 2005;87:1423-1429.

81 Oda T, Panjabi MM. Pedicle screw adjustments affect stability of thoracolumbar burst fracture. *Spine* 2001;26:2328–33.

82 Hetherington H, Earlam RJ. Measurement of disability after multiple injuries: The functional independence measure: Clinical review [review] [60 refs]. Eur J Surg 1995;161:549–55.

83 Knop, Christian MD *; Fabian, Henry F. MD +; Bastian, Leonard MD *; Blauth, Michael MD * Late Results of Thoracolumbar Fractures After Posterior Instrumentation and Transpedicular Bone Grafting. Spine. 26(1):88-99, January 1, 2001.

84 Abe, Eiji MD *; Sato, Kozo MD *; Shimada, Yoichi MD *; Mizutani, Yoichi MD +; Chiba, Mitsuho MD *; Okuyama, Koichiro MD ++ Thoracolumbar Burst Fracture With Horizontal Fracture of the Posterior Column. Spine. 22(1):83-87, January 1, 1997.

85 The Successful Short-term Treatment of Flexion-distraction Injuries of the Thoracic Spine Using Posterior-only Pedicle Screw Instrumentation Samuel Abraham Joseph, Jr, MD, Mark Stephen,

ANNEXURE II

NAME	HOSPITAL NO	AGE	AGE CODE	SEX	SEX CODE	DATE OF INJURY	SURGERY DATE	DELAY IN SURGICAL MANAGEM ENT-NUMBER	ASSOCIATED INJURY	ASSOCITE D INJURY CODE	MARRIED /UNMARRIED	EDUCATION	OCCUPATION	MONTHLY INCOME	MOI	MOI CODE
p raman	993959B	34	4	m	1	3/20/2001	3/24/2001	5	isolated	0	m	illiterate	labourer	INR 2,500	fall	1
malliga	818827C	47	5	f	2	5/14/2006	5/17/2006	3	right tibia#	1	m	illiterate	labourer	INR 1,500	fall	1
siva	823728C	20	2	m	1	5/30/2006	5/20/2006	11	contiguous	0	unm	school	student	INR 3,000	fall	1
moorthy	940932B	28	3	m	1	10/2/2000	10/11/2005	9	isolated	0	m	illiterate	farmer	INR 2,000	fall	1
a hussain	876470c	22	3	m	1	8/26/2006	8/29/2006	3	isolated	0	m	school	labourer	INR 2,000	rta	3
md ali	852243C	28	3	m	1	6/20/2006	7/12/2006	22	isolated	0	unm	school	labourer	INR 2,000	fall	1
lakshmi	613302C	34	4	f	2	3/27/2005	4/1/2005	1	left hip dislocaion	1	m	illiterate	labourer	INR 1,500	fall	1
prabhu	562239C	21	3	m	1	6/12/2004	7/12/2004	31	isolated	0	unm	illiterate	labourer	INR 1,500	fall	1
r chandran	623655C	42	5	m	1	4/29/2005	5/3/2005	5	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
r n jana	580573C	37	4	m	1	1/2/2005	1/21/2005	22	isolated	0	m	illiterate	labourer	INR 2,000	heavy object	2
deepa n	589007c	21	3	f	2	1/27/2005	1/28/2005	1	medial malleolus	1	unm	school	student	INR 3,000	fall	1
arumugam p	603437C	51	6	m	1	3/3/2005	3/8/2005	5	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
pichandi a	680577C	30	3	m	1	7/31/2005	8/9/2005	9	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
s ghosh	752711C	29	3	m	1	12/25/2005	1/4/2006	9	isolated	0	m	school	farmer	INR 3,000	fall	1
vinayagam	881477B	30	3	m	1	11/29/2000	12/1/2000	2	bladder rupture	3	m	illiterate	labourer	INR 2,500	fall	1
gp singh	764436C	19	2	m	1	1/14/2006	1/25/2006	12	talus#	1	unm	school	business	INR 5,000	fall	1
n r inala	854406C	30	3	m	1	7/10/2006	7/14/2006	5	isolated	0	m	school	labourer	INR 2,000	fall	1
kesavan g	006213C	49	5	m	1	3/2/2006	3/14/2006	15	#humerus	2	m	school	watchman	INR 4,000	fall	1
b kumar	698827C	20	2	m	1	8/9/2005	9/13/2005	34	isolated	0	um	school	farmer	INR 3,000	fall	1
kasiammal	157941C	27	3	f	2	5/9/2002	5/12/2002	3	isolated	0	m	illiterate	labourer	INR 1,000	fall	1
annamalai	400709c	36	4	m	1	1/20/2004	1/22/2004	2	distal radius/scap	2	m	illiterate	labourer	INR 2,000	rta	3
gp samantha	009992c	30	3	m	1	4/1/2001	4/15/2001	14	isolated	0	m	school	labourer	INR 2,000	fall	1
kumar n	895454c	39	4	m	1	7days	9/27/2006	7	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
sunder	061378c	47	5	m	1	9/5/2001	9/8/2001	3	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
chandran	849484b	33	4	m	1	8/16/2001	8/18/2001	2	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
saravanan	876293C	28	3	m	1	8/20/2006	8/25/2006	6	isolated	0	unm	school	labourer	INR 1,000	heavy object	2
subramani	922537C	51	6	m	1	11/6/2006	11/7/2006	1	talus#	1	m	illiterate	labourer	INR 1,500	rta	3
s kumar k	463127C	43	5	m	1	5/7/2004	5/12/2004	6	isolated	0	m	degree	business	INR 20,000	fall	1
suresh e	400499C	34	4	m	1	4/8/2007	4/24/2007	17	isolated	0	unm	school	business	INR 5,000	fall	1
f saha	169574C	40	4	m	1	1/6/2002	6/15/2002	165	isolated	0	m	illiterate	labourer	INR 2,500	fall	1
ramesh p	227973C	26	3	m	1	12/1/2002	7/16/2003	210	isolated	0	unm	school	labourer	INR 1,500	rta	3
kumar n	932352c	38	4	m	1	11/22/2006	11/28/2006	7	isolated	0	m	illiterate	labourer	INR 2,000	fall	1
nasibunnisa	026316C	27	3	f	2	5/23/2001	5/26/2001	3	isolated	0	unm	school	housewife	INR 3,000	fall	1
vediappan r	075998C	41	5	m	1	10/24/2001	10/30/2001	7	isolated	0	m	illiterate	labourer	INR 1,000	fall	1
k devi	425644C	38	4	f	2	1/20/2004	4/14/2004	84	isolated	0	m	illiterate	housewife	INR 3,000	fall	1
abdulla	818795c	27	3	m	1	5/13/2006	5/24/2006	11	isolated	0	unm	school	labourer	INR 3,000	heavy object	2
h prasad	767078C	26	3	m	1	1/31/2006	2/4/2006	5	isolated	0	m	school	labourer	INR 1,500	fall	1
s sundaram	636273C	27	3	m	1	5/17/2005	5/20/2005	4	bladder rupture	3	m	school	farmer	INR 2,000	fall	1
h ali	862041C	36	4	m	1	6/24/2006	8/16/2006	8	isolated	0	m	school	labourer	INR 1,000	fall	1
muthu	842671C	29	3	m	1	6/22/2006	6/28/2006	6	isolated	0	unm	illiterate	farmer	INR 3,000	fall	1

HEIGHT	VERTEBRA L LEVEL	VERTEBRA L LEVEL CODE	ASIA GRADING	ASIA PRE-OP GRADING CODE	ASIA GRADIND FINAL	ASIA GRADE FINAL CODE	RECOVE RY CODE	PREOP FIM SCORE	POST OP FIM SCORE	POST REHAB FIM SCORE	FINAL FIM SCORE	PRE-OP KYPHOTIC ANGLE	PRE-OP KYPHOTI C ANGLE CODE	POST OP KYPHOTI C ANGLE	POST OP KYPHOTI C ANGLE CODE	FOLLOW UP KYPHOTI C ANGLE	FOLLOW-UP KYPHOTI C ANGLE CODE
16	l2	4	E	5	E	5	2	95	100	126	126	12	3	0	1	0	1
20	l1	1	E	5	E	5	2	90	90	126	126	30	4	24	4	26	4
12	l1/l2	2	E	5	E	5	2	90	100	126	126	19	3	2	1	2	1
12	d12	2	E	5	E	5	2	100	100	126	126	12	3	3	1	3	1
0	d12	2	E	5	E	5	2	95	100	126	126	18	3	8	2	18	3
10	l1	3	E	5	E	5	2	100	110	126	126	22	4	17	3	20	3
20	l1	3	E	5	E	5	2	110	110	126	126	20	3	0	1	0	1
15	l2	4	A	1	A	1	0	49	52	77	80	13	3	3	1	3	1
25	l1	3	A	1	E	5	1	48	48	78	106	10	2	2	1	9	2
0	l2	4	A	1	A	1	0	48	50	77	85	11	3	3	1	3	1
15	l1	3	A	1	D	4	1	48	48	80	110	20	3	4	1	4	1
15	d12	2	A	1	A	1	0	49	59	70	90	34	4	2	1	2	1
7	l1	3	A	1	A	1	0	48	50	70	80	21	4	7	2	7	2
18	d12	2	A	1	C	3	1	48	52	75	108	42	4	9	2	9	2
20	d12	2	A	1	A	1	0	48	55	70	100	10	2	3	1	3	1
20	l1	3	A	1	C	3	1	50	64	88	100	23	4	2	1	2	1
12	l1	3	A	1	A	1	0	77	80	80	93	8	2	2	1	2	1
10	d12	2	A	1	A	1	1	48	48	79	110	28	4	11	3	11	3
15	d12	2	A	1	A	1	0	48	52	77	85	40	4	18	3	18	3
25	l1	3	A	1	E	5	1	48	48	70	120	44	4	3	1	3	1
0	d12	2	A	1	A	1	0	48	50	80	80	20	3	12	3	20	3
20	l1	3	A	1	D	4	1	48	50	80	115	20	3	10	2	15	3
10	d11	1	A	1	A	1	0	49	54	77	86	20	3	5	1	5	1
12	d12	2	A	1	A	1	0	48	55	80	86	17	3	3	1	3	1
15	d12	2	A	1	A	1	0	48	52	80	90	15	3	0	1	0	1
0	l1	3	A	1	A	1	1	55	57	80	96	22	4	9	2	15	3
0	l1	3	A	1	A	1	0	48	48	75	78	26	4	4	1	4	1
40	d12	2	A	1	A	1	0	48	48	80	95	22	4	3	1	3	1
30	l1	3	A	1	A	1	1	48	50	75	110	23	4	11	3	11	3
20	d12	2	A	1	A	1	0	48	52	77	90	30	4	3	1	14	3
0	l1	3	A	1	A	1	0	48	50	74	88	17	3	6	2	6	2
18	l1	3	B	2	C	3	1	75	75	90	100	22	4	4	1	4	1
15	l1	3	B	2	D	4	1	48	50	75	105	12	3	10	2	11	3
30	d12	2	C	3	E	5	1	70	70	88	100	24	4	8	2	10	2
4	d12	2	C	3	E	5	1	77	80	80	100	27	4	13	3	13	3
0	l2	4	C	3	E	5	1	50	70	85	126	30	4	7	2	9	2
15	d12	2	C	3	E	5	1	50	70	90	100	25	4	5	1	10	2
20	l2	4	C	3	E	5	1	80	85	90	105	18	3	2	1	2	1
12	l1	3	D	4	E	5	1	50	65	90	100	28	4	14	3	14	3
6	d12	2	C	3	E	5	1	55	60	90	110	20	3	2	1	2	1

LOSS IN KYPHOSIS	LOSS IN KYPHOSIS CODE	ANTERIOR COLUMN RECONSTRUCTION	ANTERIOR COLUMN RECONSTRUCTION CODE	LEVEL OF FIXATION	AO	AO-CODE	DENIS	DENIS-CODE	TLISS	TYPE OF SURGERY	TYPE OF SURGERY CODE	TRANSLATION PRE-OP	TRANSLATION CODE	TRANSLATION POST-OP	POST OP TRANSLATION CODE	LOSS OF TRANSLATION REDUTION	COMPLAINT	COMPLICATIONS CODE	GRAFT UNION
0	1	0	0	1	B2	2	SB-B	2	7	p	1	0	0	0	0	0	nil	0	0
0	1	c	2	1	B1	1	SB-S	1	7	ap	3	0	0	0	0	0	ba	1	united
0	1	tci	1	1	B2	2	FD	3	7	ap	3	3	1	0	0	0	nil	0	united
0	1	tci	1	1	B2	2	SB-B	2	7	ap	3	0	0	0	0	0	nil	0	united
10	2	tci	1	2	B1	1	SB-S	1	7	p	1	0	0	0	0	0	ba	1	united
3	1	tci	1	1	B1	1	SB-S	1	7	ap	3	0	0	0	0	0	ba	1	united
0	1	tci	1	1	B2	2	SB-B	2	7	ap	3	0	0	0	0	0	hip arthritis	0	united
0	1	tci	1	1	B2	2	SB-B	2	9	ap	3	4	1	4	1	0	nil	0	united
7	2	tci	1	1	B1	1	SB-S	1	9	ap	3	0	0	0	0	0	nil	0	united
0	1	tci	1	1	B1	1	SB-S	1	9	ap	3	0	0	0	0	0	nil	0	united
0	1	tci	1	1	B2	2	SB-B	2	9	ap	3	0	0	0	0	0	ba	1	united
0	1	tci	1	1	B1	1	SB-S	1	9	ap	3	0	0	0	0	0	preassure	2	united
0	1	tci	1	2	B1	1	SB-S	1	9	ep	2	0	0	0	0	0	nil	0	united
0	1	tci	1	1	B2	2	FD	3	9	ap	3	0	0	0	0	0	ba	1	united
0	1	c	2	1	B2	2	SB-B	2	9	ap	3	2	1	2	1	0	nil	0	united
0	1	tci	1	1	B1	1	SB-S	1	9	ap	3	0	0	0	0	0	nil	0	united
0	1	tci	1	1	B1	1	SB-S	1	9	ap	3	0	0	0	0	0	heel ulcer	2	united
0	1	tci	1	1	B2	2	SB-B	2	9	ap	3	7	2	3	1	0	donor site	4	united
0	1	tci	1	2	B2	2	FD	3	9	ep	2	4	1	3	1	0	ulcer	2	united
0	1	tci	1	1	B1	1	SB-S	1	9	ap	3	12	3	8	2	0	nil	0	united
8	2	tci	1	2	B1	1	FD	3	9	ep	2	12	3	0	0	0	u	2	united
5	1	tci	1	2	B1	1	SB-S	1	9	ep	2	4	1	4	1	0	ba/screw b	3	united
0	1	c	2	2	B1	1	FD	3	9	ep	2	20	3	0	0	0	nil	0	united
0	1	0	0	1	B2	2	SB-B	2	9	p	1	0	0	0	0	0	nil	0	0
0	1	c	2	1	B2	2	SB-B	2	9	ap	3	0	0	0	0	0	nil	0	united
6	2	tci	1	1	B2	2	SB-B	2	9	ap	3	0	0	0	0	0	nil	0	united
0	1	tci	1	2	C2	3	FD	3	9	ep	2	8	2	3	1	0	nil	0	united
0	1	tci	1	2	B2	2	FD	3	9	ep	2	8	2	0	0	0	nil	0	united
0	1	c	2	2	B2	2	SB-B	2	9	ep	2	8	2	0	0	0	nil	0	united
11	3	c	2	2	B2	2	FD	3	9	ep	2	10	2	3	1	0	ba	1	united
0	1	tci	1	2	B2	2	SB-B	2	9	ep	2	2	1	0	0	0	heel ulcer	2	united
0	1	c	2	1	B2	2	SB-B	2	10	ap	3	4	1	2	1	0	nil	0	united
1	1	0	0	1	B2	2	SB-B	2	10	p	1	4	1	0	0	0	ba	1	0
2	1	tci	1	1	B2	2	SB-B	2	10	ap	3	3	1	3	1	0	nil	0	united
0	1	tci	1	2	B2	2	SB-B	2	10	ap	3	0	0	0	0	0	ba	1	united
2	1	tci	1	1	B2	2	SB-B	2	10	ap	3	0	0	0	0	0	nil	0	united
5	1	0	0	2	B1	1	SB-S	1	10	ep	2	3	1	0	0	0	nil	0	united
0	1	tci	1	2	B2	2	SB-B	2	10	ep	2	6	2	0	0	0	nil	0	united
0	1	tci	1	1	B1	1	FD	3	10	ap	3	4	1	4	1	1	ba	1	united
0	1	tci	1	1	B2	2	SB-B	2	10	ap	3	0	0	0	0	0	nil	0	united

TOTAL FOLLOW UP MONTHS
81
26
29
84
20
10
39
77
41
46
15
14
38
18
84
15
20
30
13
80
60
90
20
77
85
15
13
22
16
26
60
22
36
78
13
25
18
20
13
16

ANNUXURE III

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
AGECO * SEXCO	40	100.0%	0	.0%	40	100.0%

AGECO * SEXCO Crosstabulation

			SEXCO		Total
			1	2	
AGECO	11-20	Count	3		3
		% within SEXCO	8.8%		7.5%
	21=30	Count	15	3	18
		% within SEXCO	44.1%	50.0%	45.0%
	31-40	Count	9	2	11
		% within SEXCO	26.5%	33.3%	27.5%
	41-50	Count	5	1	6
		% within SEXCO	14.7%	16.7%	15.0%
	51-60	Count	2		2
		% within SEXCO	5.9%		5.0%
Total		Count	34	6	40
		% within SEXCO	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.022[a]	4	.906
Likelihood Ratio	1.759	4	.780
Linear-by-Linear Association	.002	1	.965
N of Valid Cases	40		

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .30.

```
FREQUENCIES
  VARIABLES=assinjyc
  /ORDER=  ANALYSIS .
```

Frequencies

Statistics

ASSINJYCO

N	Valid	40
	Missing	0

ASSINJYCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	31	77.5	77.5	77.5
	1	5	12.5	12.5	90.0
	2	2	5.0	5.0	95.0
	3	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

```
FREQUENCIES
  VARIABLES=moico
  /ORDER=  ANALYSIS .
```

Frequencies

Statistics

MOICO

N	Valid	40
	Missing	0

MOICO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	33	82.5	82.5	82.5
	2	3	7.5	7.5	90.0
	3	4	10.0	10.0	100.0
	Total	40	100.0	100.0	

```
FREQUENCIES
  VARIABLES=vertlelc asiaprec moico asifinco recoco prkyphc pokyphco
folkypho
  lo_kypho antrecon tysurco transco complico posttran
  /ORDER=  ANALYSIS .
```

Frequencies

Statistics

		VERTLELCO	ASIAPRECO	MOICO	ASIFINCO	RECOCO	PREKYPHOCO	POKYPHCO	FOLKYPHOTICO	LO KYPHOCO	ANTRECONCO	TYSURCO	TRANSCO	COMPLICO	POSTTRANSCO
N	Valid	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Frequency Table

VERTLELCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	5.0	5.0	5.0
	2	17	42.5	42.5	47.5
	3	16	40.0	40.0	87.5
	4	5	12.5	12.5	100.0
	Total	40	100.0	100.0	

ASIAPRECO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	24	60.0	60.0	60.0
	2	2	5.0	5.0	65.0
	3	6	15.0	15.0	80.0
	4	1	2.5	2.5	82.5
	5	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

MOICO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	33	82.5	82.5	82.5
	2	3	7.5	7.5	90.0
	3	4	10.0	10.0	100.0
	Total	40	100.0	100.0	

ASIFINCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	18	45.0	45.0	45.0
	3	3	7.5	7.5	52.5
	4	3	7.5	7.5	60.0
	5	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

RECOCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	15	37.5	37.5	37.5
	1	18	45.0	45.0	82.5
	2	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

PREKYPHOCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	7.5	7.5	7.5
	3	17	42.5	42.5	50.0
	4	20	50.0	50.0	100.0
	Total	40	100.0	100.0	

POKYPHCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	23	57.5	57.5	57.5
	2	9	22.5	22.5	80.0
	3	7	17.5	17.5	97.5
	4	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

FOLKYPHOTICO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	20	50.0	50.0	50.0
	2	7	17.5	17.5	67.5
	3	12	30.0	30.0	97.5
	4	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

LO KYPHOCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	35	87.5	87.5	87.5
	2	4	10.0	10.0	97.5
	3	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

ANTRECONCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	4	10.0	10.0	10.0
	1	29	72.5	72.5	82.5
	2	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

TYSURCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	10.0	10.0	10.0
	2	12	30.0	30.0	40.0
	3	24	60.0	60.0	100.0
	Total	40	100.0	100.0	

TRANSCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	20	50.0	50.0	50.0
	1	11	27.5	27.5	77.5
	2	6	15.0	15.0	92.5
	3	3	7.5	7.5	100.0
	Total	40	100.0	100.0	

COMPLICO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	24	60.0	60.0	60.0
	1	9	22.5	22.5	82.5
	2	5	12.5	12.5	95.0
	3	1	2.5	2.5	97.5
	4	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

POSTTRANSCO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	29	72.5	72.5	72.5
	1	10	25.0	25.0	97.5
	2	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

```
CROSSTABS
  /TABLES=asifinco  BY asiaprec
  /FORMAT= AVALUE TABLES
  /STATISTIC=CHISQ
  /CELLS= COUNT COLUMN .
```

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
ASIFINCO * ASIAPRECO	40	100.0%	0	.0%	40	100.0%

ASIFINCO * ASIAPRECO Crosstabulation

			ASIAPRECO					Total
			1	2	3	4	5	
ASIFINCO	1	Count	18					18
		% within ASIAPRECO	75.0%					45.0%
	3	Count	2	1				3
		% within ASIAPRECO	8.3%	50.0%				7.5%
	4	Count	2	1				3
		% within ASIAPRECO	8.3%	50.0%				7.5%
	5	Count	2		6	1	7	16
		% within ASIAPRECO	8.3%		100.0%	100.0%	100.0%	40.0%
Total		Count	24	2	6	1	7	40
		% within ASIAPRECO	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.194[a]	12	.000
Likelihood Ratio	46.203	12	.000
Linear-by-Linear Association	22.613	1	.000
N of Valid Cases	40		

a. 18 cells (90.0%) have expected count less than 5. The minimum expected count is .08.

```
RECODE
  asiaprec
  (MISSING=5)  (1 thru 2,3=1)  (4 thru 5=2)  INTO  ASIPRE1 .
EXECUTE .
CROSSTABS
  /TABLES=asifinco  BY asipre1
  /FORMAT= AVALUE TABLES
  /STATISTIC=CHISQ
  /CELLS= COUNT COLUMN .
```

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
ASIFINCO * ASIPRE1	33	82.5%	7	17.5%	40	100.0%

ASIFINCO * ASIPRE1 Crosstabulation

			ASIPRE1		Total
			1.00	2.00	
ASIFINCO	1	Count	18		18
		% within ASIPRE1	69.2%		54.5%
	3	Count	3		3
		% within ASIPRE1	11.5%		9.1%
	4	Count	3		3
		% within ASIPRE1	11.5%		9.1%
	5	Count	2	7	9
		% within ASIPRE1	7.7%	100.0%	27.3%
Total		Count	26	7	33
		% within ASIPRE1	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.692[a]	3	.000
Likelihood Ratio	24.571	3	.000
Linear-by-Linear Association	16.441	1	.000
N of Valid Cases	33		

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .64.

```
RECODE
  asifinco
  (MISSING=5)  (1 thru 2=1)  (3 thru 4=2)  INTO  ASIFI1 .
EXECUTE .
T-TEST
  GROUPS=asipre1(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=postfim rehabfim finfim
  /CRITERIA=CIN(.95) .
```

T-Test

Group Statistics

	ASIPRE1	N	Mean	Std. Deviation	Std. Error Mean
POSTFIM	1.00	26	53.73	7.998	1.568
	2.00	7	71.43	8.522	3.221
REHABFIM	1.00	26	77.46	4.827	.947
	2.00	7	87.57	3.823	1.445
FINFIM	1.00	26	95.62	12.017	2.357
	2.00	7	105.86	9.668	3.654

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POSTFIM	Equal variances assumed	.170	.683	-5.130	31	.000	-17.70	3.450	-24.734	-10.662
	Equal variances not assumed			-4.940	9.061	.001	-17.70	3.583	-25.794	-9.602
REHABFIM	Equal variances assumed	.209	.651	-5.106	31	.000	-10.11	1.980	-14.148	-6.072
	Equal variances not assumed			-5.852	11.735	.000	-10.11	1.728	-13.883	-6.336
FINFIM	Equal variances assumed	1.613	.214	-2.074	31	.047	-10.24	4.939	-20.315	-.168
	Equal variances not assumed			-2.355	11.549	.037	-10.24	4.348	-19.757	-.726

```
T-TEST
  GROUPS=asifi1(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=postfim rehabfim finfim
  /CRITERIA=CIN(.95) .
```

T-Test

Group Statistics

	ASIFI1	N	Mean	Std. Deviation	Std. Error Mean
POSTFIM	1.00	18	53.44	7.318	1.725
	2.00	6	56.50	10.728	4.380
REHABFIM	1.00	18	76.56	3.585	.845
	2.00	6	81.33	6.377	2.603
FINFIM	1.00	18	90.11	9.393	2.214
	2.00	6	106.33	5.888	2.404

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POSTFIM	Equal variances assumed	2.643	.118	-.789	22	.439	-3.06	3.874	-11.090	4.979
	Equal variances not assumed			-.649	6.624	.538	-3.06	4.707	-14.316	8.205
REHABFIM	Equal variances assumed	4.264	.051	-2.315	22	.030	-4.78	2.064	-9.058	-.497
	Equal variances not assumed			-1.746	6.089	.131	-4.78	2.737	-11.452	1.896
FINFIM	Equal variances assumed	.854	.365	-3.946	22	.001	-16.22	4.111	-24.748	-7.697
	Equal variances not assumed			-4.964	14.097	.000	-16.22	3.268	-23.227	-9.218

```
RECODE
  tysurco
  (1=1)  (2 thru 3=2)  INTO  TYSUGR1 .
EXECUTE .
```

```
T-TEST
  GROUPS=tysugr1(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=postfim rehabfim finfim prekypho postkyph fol_kyph
  /CRITERIA=CIN(.95) .
```

T-Test

Group Statistics

	TYSUGR1	N	Mean	Std. Deviation	Std. Error Mean
POSTFIM	1.00	4	76.25	27.500	13.750
	2.00	36	63.94	18.812	3.135
REHABFIM	1.00	4	101.75	28.076	14.038
	2.00	36	86.17	17.259	2.876
FINFIM	1.00	4	110.75	19.242	9.621
	2.00	36	101.83	15.070	2.512
PREKYPHO	1.00	4	14.75	3.202	1.601
	2.00	36	22.67	8.562	1.427
POSTKYPHOTIC	1.00	4	5.25	4.573	2.287
	2.00	36	6.47	5.557	.926
FOL KYPHOTIC	1.00	4	8.00	8.124	4.062
	2.00	36	7.89	6.528	1.088

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POSTFIM	Equal variances assumed	2.451	.126	1.189	38	.242	12.31	10.350	-8.647	33.258
	Equal variances not assumed			.873	3.319	.441	12.31	14.103	-30.230	54.841
REHABFIM	Equal variances assumed	3.915	.055	1.612	38	.115	15.58	9.669	-3.991	35.157
	Equal variances not assumed			1.087	3.257	.351	15.58	14.330	-28.052	59.219
FINFIM	Equal variances assumed	.434	.514	1.096	38	.280	8.92	8.138	-7.558	25.391
	Equal variances not assumed			.897	3.422	.428	8.92	9.943	-20.633	38.466
PREKYPHO	Equal variances assumed	1.565	.219	-1.817	38	.077	-7.92	4.357	-16.737	.903
	Equal variances not assumed			-3.692	9.167	.005	-7.92	2.145	-12.754	-3.079
POSTKYPHOTIC	Equal variances assumed	.154	.697	-.423	38	.675	-1.22	2.891	-7.076	4.631
	Equal variances not assumed			-.495	4.056	.646	-1.22	2.467	-8.035	5.591
FOL KYPHOTIC	Equal variances assumed	.340	.563	.032	38	.975	.11	3.514	-7.003	7.226
	Equal variances not assumed			.026	3.444	.980	.11	4.205	-12.346	12.568

```
T-TEST
  PAIRS= postkyph transpre  WITH fol_kyph transpos (PAIRED)
  /CRITERIA=CIN(.95)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	POSTKYPHOTIC	6.35	40	5.428	.858
	FOL KYPHOTIC	7.90	40	6.582	1.041
Pair 2	TRANSPRE	3.20	40	4.490	.710
	TRANSPOST	.98	40	1.804	.285

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	POSTKYPHOTIC - FOL KYPHOTIC	-1.55	2.978	.471	-2.50	-.60	-3.292	39	.002
Pair 2	TRANSPRE - TRANSPOST	2.23	4.111	.650	.91	3.54	3.423	39	.001

```
ONEWAY
  prekypho postkyph fol_kyph transpre transpos rehabfim finfim postfim
BY
  tysurco
  /MISSING ANALYSIS .
```

Oneway

```
ONEWAY
  prekypho postkyph fol_kyph transpre transpos rehabfim finfim postfim
BY
  tysurco
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS .
```

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PREKYPHO	1	4	14.75	3.202	1.601	9.66	19.84	12	18
	2	12	23.50	6.332	1.828	19.48	27.52	17	40
	3	24	22.25	9.584	1.956	18.20	26.30	8	44
	Total	40	21.88	8.507	1.345	19.15	24.60	8	44
POSTKYPHOTIC	1	4	5.25	4.573	2.287	-2.03	12.53	0	10
	2	12	7.17	4.726	1.364	4.16	10.17	2	18
	3	24	6.13	5.995	1.224	3.59	8.66	0	24
	Total	40	6.35	5.428	.858	4.61	8.09	0	24
FOL KYPHOTIC	1	4	8.00	8.124	4.062	-4.93	20.93	0	18
	2	12	9.58	6.052	1.747	5.74	13.43	2	20
	3	24	7.04	6.715	1.371	4.21	9.88	0	26
	Total	40	7.90	6.582	1.041	5.79	10.01	0	26
TRANSPRE	1	4	1.00	2.000	1.000	-2.18	4.18	0	4
	2	12	7.08	5.351	1.545	3.68	10.48	0	20
	3	24	1.63	2.946	.601	.38	2.87	0	12
	Total	40	3.20	4.490	.710	1.76	4.64	0	20
TRANSPOST	1	4	.00	.000	.000	.00	.00	0	0
	2	12	1.08	1.621	.468	.05	2.11	0	4
	3	24	1.08	2.020	.412	.23	1.94	0	8
	Total	40	.98	1.804	.285	.40	1.55	0	8
REHABFIM	1	4	101.75	28.076	14.038	57.08	146.42	75	126
	2	12	78.75	5.987	1.728	74.95	82.55	70	90
	3	24	89.88	19.826	4.047	81.50	98.25	70	126
	Total	40	87.73	18.718	2.960	81.74	93.71	70	126
FINFIM	1	4	110.75	19.242	9.621	80.13	141.37	86	126
	2	12	92.67	12.353	3.566	84.82	100.52	78	115
	3	24	106.42	14.383	2.936	100.34	112.49	80	126
	Total	40	102.73	15.480	2.448	97.77	107.68	78	126
POSTFIM	1	4	76.25	27.500	13.750	32.49	120.01	50	100
	2	12	54.92	11.147	3.218	47.83	62.00	48	85
	3	24	68.46	20.379	4.160	59.85	77.06	48	110
	Total	40	65.18	19.742	3.121	58.86	71.49	48	110

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PREKYPHO	Between Groups	238.125	2	119.063	1.705	.196
	Within Groups	2584.250	37	69.845		
	Total	2822.375	39			
POSTKYPHOTIC	Between Groups	14.058	2	7.029	.229	.796
	Within Groups	1135.042	37	30.677		
	Total	1149.100	39			
FOL KYPHOTIC	Between Groups	51.725	2	25.863	.584	.563
	Within Groups	1637.875	37	44.267		
	Total	1689.600	39			
TRANSPRE	Between Groups	259.858	2	129.929	9.130	.001
	Within Groups	526.542	37	14.231		
	Total	786.400	39			
TRANSPOST	Between Groups	4.225	2	2.113	.637	.535
	Within Groups	122.750	37	3.318		
	Total	126.975	39			
REHABFIM	Between Groups	1864.350	2	932.175	2.923	.066
	Within Groups	11799.625	37	318.909		
	Total	13663.975	39			
FINFIM	Between Groups	1798.725	2	899.362	4.409	.019
	Within Groups	7547.250	37	203.980		
	Total	9345.975	39			
POSTFIM	Between Groups	2012.150	2	1006.075	2.823	.072
	Within Groups	13187.625	37	356.422		
	Total	15199.775	39			

```
CROSSTABS
  /TABLES=tliss aocode deniscod  BY tysurco prekypho postkyph fol_kyph
  postfim rehabfim finfim transpre transpos
  /FORMAT= AVALUE TABLES
  /STATISTIC=CHISQ
  /CELLS= COUNT COLUMN .
```

Crosstabs

TLISS * TYSURCO

Crosstab

			TYSURCO			Total
			1	2	3	
TLISS	7	Count	2		5	7
		% within TYSURCO	50.0%		20.8%	17.5%
	9	Count	1	10	13	24
		% within TYSURCO	25.0%	83.3%	54.2%	60.0%
	10	Count	1	2	6	9
		% within TYSURCO	25.0%	16.7%	25.0%	22.5%
Total		Count	4	12	24	40
		% within TYSURCO	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.968[a]	4	.138
Likelihood Ratio	8.377	4	.079
Linear-by-Linear Association	.134	1	.714
N of Valid Cases	40		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .70.

```
ONEWAY
  prekypho postkyph fol_kyph transpre transpos rehabfim finfim postfim
BY
  tliss
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS .
```

Oneway

Descriptives TLISS

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PREKYPHO	7	7	19.00	6.191	2.340	13.27	24.73	12	30
	9	24	22.33	9.933	2.028	18.14	26.53	8	44
	10	9	22.89	5.600	1.867	18.58	27.19	12	30
	Total	40	21.88	8.507	1.345	19.15	24.60	8	44
POSTKYPHOTIC	7	7	7.71	9.358	3.537	-.94	16.37	0	24
	9	24	5.63	4.342	.886	3.79	7.46	0	18
	10	9	7.22	4.438	1.479	3.81	10.63	2	14
	Total	40	6.35	5.428	.858	4.61	8.09	0	24
FOL KYPHOTIC	7	7	9.86	11.052	4.177	-.36	20.08	0	26
	9	24	7.17	5.708	1.165	4.76	9.58	0	20
	10	9	8.33	4.555	1.518	4.83	11.83	2	14
	Total	40	7.90	6.582	1.041	5.79	10.01	0	26
TRANSPRE	7	7	.43	1.134	.429	-.62	1.48	0	3
	9	24	4.21	5.357	1.093	1.95	6.47	0	20
	10	9	2.67	2.179	.726	.99	4.34	0	6
	Total	40	3.20	4.490	.710	1.76	4.64	0	20
TRANSPOST	7	7	.00	.000	.000	.00	.00	0	0
	9	24	1.25	2.069	.422	.38	2.12	0	8
	10	9	1.00	1.581	.527	-.22	2.22	0	4
	Total	40	.98	1.804	.285	.40	1.55	0	8
REHABFIM	7	7	126.00	.000	.000	126.00	126.00	126	126
	9	24	77.04	4.248	.867	75.25	78.84	70	88
	10	9	86.44	5.480	1.827	82.23	90.66	75	90
	Total	40	87.73	18.718	2.960	81.74	93.71	70	126
FINFIM	7	7	126.00	.000	.000	126.00	126.00	126	126
	9	24	95.04	12.327	2.516	89.84	100.25	78	120
	10	9	105.11	8.594	2.865	98.50	111.72	100	126
	Total	40	102.73	15.480	2.448	97.77	107.68	78	126
POSTFIM	7	7	101.43	6.901	2.608	95.05	107.81	90	110
	9	24	53.00	6.978	1.424	50.05	55.95	48	80
	10	9	69.44	10.442	3.481	61.42	77.47	50	85
	Total	40	65.18	19.742	3.121	58.86	71.49	48	110

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PREKYPHO	Between Groups	72.153	2	36.076	.485	.619
	Within Groups	2750.222	37	74.330		
	Total	2822.375	39			
POSTKYPHOTIC	Between Groups	32.491	2	16.245	.538	.588
	Within Groups	1116.609	37	30.179		
	Total	1149.100	39			
FOL KYPHOTIC	Between Groups	41.410	2	20.705	.465	.632
	Within Groups	1648.190	37	44.546		
	Total	1689.600	39			
TRANSPRE	Between Groups	80.727	2	40.364	2.116	.135
	Within Groups	705.673	37	19.072		
	Total	786.400	39			
TRANSPOST	Between Groups	8.475	2	4.238	1.323	.279
	Within Groups	118.500	37	3.203		
	Total	126.975	39			
REHABFIM	Between Groups	13008.794	2	6504.397	367.323	.000
	Within Groups	655.181	37	17.708		
	Total	13663.975	39			
FINFIM	Between Groups	5260.128	2	2630.064	23.817	.000
	Within Groups	4085.847	37	110.428		
	Total	9345.975	39			
POSTFIM	Between Groups	12921.838	2	6460.919	104.943	.000
	Within Groups	2277.937	37	61.566		
	Total	15199.775	39			

```
ONEWAY
  prekypho postkyph fol_kyph transpre transpos rehabfim finfim postfim
BY
  deniscod
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS .
```

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PREKYPHO	1	12	22.17	10.373	2.995	15.58	28.76	8	44
	2	19	19.05	5.854	1.343	16.23	21.87	10	30
	3	9	27.44	8.589	2.863	20.84	34.05	19	42
	Total	40	21.88	8.507	1.345	19.15	24.60	8	44
POSTKYPHOTIC	1	12	7.08	6.973	2.013	2.65	11.51	2	24
	2	19	5.21	4.090	.938	3.24	7.18	0	13
	3	9	7.78	5.740	1.913	3.37	12.19	2	18
	Total	40	6.35	5.428	.858	4.61	8.09	0	24
FOL KYPHOTIC	1	12	9.75	8.226	2.375	4.52	14.98	2	26
	2	19	5.79	4.791	1.099	3.48	8.10	0	15
	3	9	9.89	6.809	2.270	4.66	15.12	2	20
	Total	40	7.90	6.582	1.041	5.79	10.01	0	26
TRANSPRE	1	12	1.58	3.554	1.026	-.67	3.84	0	12
	2	19	2.11	2.685	.616	.81	3.40	0	8
	3	9	7.67	5.958	1.986	3.09	12.25	0	20
	Total	40	3.20	4.490	.710	1.76	4.64	0	20
TRANSPOST	1	12	1.00	2.486	.718	-.58	2.58	0	8
	2	19	.74	1.327	.304	.10	1.38	0	4
	3	9	1.44	1.740	.580	.11	2.78	0	4
	Total	40	.98	1.804	.285	.40	1.55	0	8
REHABFIM	1	12	90.08	22.573	6.516	75.74	104.43	70	126
	2	19	87.95	17.846	4.094	79.35	96.55	70	126
	3	9	84.11	16.359	5.453	71.54	96.69	75	126
	Total	40	87.73	18.718	2.960	81.74	93.71	70	126
FINFIM	1	12	105.58	16.757	4.837	94.94	116.23	80	126
	2	19	104.95	14.034	3.220	98.18	111.71	80	126
	3	9	94.22	15.287	5.096	82.47	105.97	78	126
	Total	40	102.73	15.480	2.448	97.77	107.68	78	126
POSTFIM	1	12	68.25	21.926	6.329	54.32	82.18	48	110
	2	19	66.68	19.827	4.549	57.13	76.24	48	110
	3	9	57.89	16.586	5.529	45.14	70.64	48	100
	Total	40	65.18	19.742	3.121	58.86	71.49	48	110

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PREKYPHO	Between Groups	431.539	2	215.769	3.339	.046
	Within Groups	2390.836	37	64.617		
	Total	2822.375	39			
POSTKYPHOTIC	Between Groups	49.470	2	24.735	.832	.443
	Within Groups	1099.630	37	29.720		
	Total	1149.100	39			
FOL KYPHOTIC	Between Groups	161.303	2	80.652	1.953	.156
	Within Groups	1528.297	37	41.305		
	Total	1689.600	39			
TRANSPRE	Between Groups	233.694	2	116.847	7.822	.001
	Within Groups	552.706	37	14.938		
	Total	786.400	39			
TRANSPOST	Between Groups	3.069	2	1.534	.458	.636
	Within Groups	123.906	37	3.349		
	Total	126.975	39			
REHABFIM	Between Groups	185.222	2	92.611	.254	.777
	Within Groups	13478.753	37	364.291		
	Total	13663.975	39			
FINFIM	Between Groups	842.555	2	421.278	1.833	.174
	Within Groups	8503.420	37	229.822		
	Total	9345.975	39			
POSTFIM	Between Groups	634.531	2	317.265	.806	.454
	Within Groups	14565.244	37	393.655		
	Total	15199.775	39			

```
ONEWAY
  prekypho postkyph fol_kyph transpre transpos rehabfim finfim postfim
BY
  aocode
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS .
```

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PREKYPHO	1	15	22.27	9.362	2.417	17.08	27.45	8	44
	2	24	21.46	8.267	1.688	17.97	24.95	10	42
	3	1	26.00	.	.	.	.	26	26
	Total	40	21.88	8.507	1.345	19.15	24.60	8	44
POSTKYPHOTIC	1	15	7.73	6.573	1.697	4.09	11.37	2	24
	2	24	5.58	4.643	.948	3.62	7.54	0	18
	3	1	4.00	.	.	.	.	4	4
	Total	40	6.35	5.428	.858	4.61	8.09	0	24
FOL KYPHOTIC	1	15	10.40	7.944	2.051	6.00	14.80	2	26
	2	24	6.50	5.316	1.085	4.26	8.74	0	18
	3	1	4.00	.	.	.	.	4	4
	Total	40	7.90	6.582	1.041	5.79	10.01	0	26
TRANSPRE	1	15	3.67	6.137	1.585	.27	7.07	0	20
	2	24	2.71	3.141	.641	1.38	4.03	0	10
	3	1	8.00	.	.	.	.	8	8
	Total	40	3.20	4.490	.710	1.76	4.64	0	20
TRANSPOST	1	15	1.07	2.374	.613	-.25	2.38	0	8
	2	24	.83	1.373	.280	.25	1.41	0	4
	3	1	3.00	.	.	.	.	3	3
	Total	40	.98	1.804	.285	.40	1.55	0	8
REHABFIM	1	15	88.53	20.427	5.274	77.22	99.85	70	126
	2	24	87.75	18.238	3.723	80.05	95.45	70	126
	3	1	75.00	.	.	.	.	75	75
	Total	40	87.73	18.718	2.960	81.74	93.71	70	126
FINFIM	1	15	102.20	16.874	4.357	92.86	111.54	80	126
	2	24	104.08	14.295	2.918	98.05	110.12	80	126
	3	1	78.00	.	.	.	.	78	78
	Total	40	102.73	15.480	2.448	97.77	107.68	78	126
POSTFIM	1	15	65.87	20.266	5.233	54.64	77.09	48	110
	2	24	65.46	19.941	4.070	57.04	73.88	48	110
	3	1	48.00	.	.	.	.	48	48
	Total	40	65.18	19.742	3.121	58.86	71.49	48	110

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PREKYPHO	Between Groups	23.483	2	11.742	.155	.857
	Within Groups	2798.892	37	75.646		
	Total	2822.375	39			
POSTKYPHOTIC	Between Groups	48.333	2	24.167	.812	.452
	Within Groups	1100.767	37	29.750		
	Total	1149.100	39			
FOL KYPHOTIC	Between Groups	156.000	2	78.000	1.882	.167
	Within Groups	1533.600	37	41.449		
	Total	1689.600	39			
TRANSPRE	Between Groups	32.108	2	16.054	.787	.462
	Within Groups	754.292	37	20.386		
	Total	786.400	39			
TRANSPOST	Between Groups	4.708	2	2.354	.712	.497
	Within Groups	122.267	37	3.305		
	Total	126.975	39			
REHABFIM	Between Groups	171.742	2	85.871	.235	.791
	Within Groups	13492.233	37	364.655		
	Total	13663.975	39			
FINFIM	Between Groups	659.742	2	329.871	1.405	.258
	Within Groups	8686.233	37	234.763		
	Total	9345.975	39			
POSTFIM	Between Groups	304.083	2	152.042	.378	.688
	Within Groups	14895.692	37	402.586		
	Total	15199.775	39			

```
ONEWAY
  prekypho postkyph fol_kyph transpre transpos rehabfim finfim postfim
BY
  antrecon
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS .
```

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PREKYPHO	0	4	16.50	6.137	3.069	6.73	26.27	12	25
	1	29	22.72	8.960	1.664	19.32	26.13	8	44
	2	7	21.43	7.345	2.776	14.64	28.22	10	30
	Total	40	21.88	8.507	1.345	19.15	24.60	8	44
POSTKYPHOTIC	0	4	4.50	4.203	2.102	-2.19	11.19	0	10
	1	29	6.41	4.925	.914	4.54	8.29	0	18
	2	7	7.14	8.153	3.082	-.40	14.68	0	24
	Total	40	6.35	5.428	.858	4.61	8.09	0	24
FOL KYPHOTIC	0	4	6.00	5.354	2.677	-2.52	14.52	0	11
	1	29	7.90	6.281	1.166	5.51	10.29	0	20
	2	7	9.00	8.907	3.367	.76	17.24	0	26
	Total	40	7.90	6.582	1.041	5.79	10.01	0	26
TRANSPRE	0	4	1.75	2.062	1.031	-1.53	5.03	0	4
	1	29	2.66	3.696	.686	1.25	4.06	0	12
	2	7	6.29	7.158	2.705	-.33	12.91	0	20
	Total	40	3.20	4.490	.710	1.76	4.64	0	20
TRANSPOST	0	4	.00	.000	.000	.00	.00	0	0
	1	29	1.10	2.006	.373	.34	1.87	0	8
	2	7	1.00	1.291	.488	-.19	2.19	0	3
	Total	40	.98	1.804	.285	.40	1.55	0	8
REHABFIM	0	4	92.75	23.027	11.514	56.11	129.39	75	126
	1	29	87.69	18.647	3.463	80.60	94.78	70	126
	2	7	85.00	19.079	7.211	67.36	102.64	70	126
	Total	40	87.73	18.718	2.960	81.74	93.71	70	126
FINFIM	0	4	104.25	16.581	8.290	77.87	130.63	86	126
	1	29	103.10	16.141	2.997	96.96	109.24	78	126
	2	7	100.29	13.973	5.281	87.36	113.21	86	126
	Total	40	102.73	15.480	2.448	97.77	107.68	78	126
POSTFIM	0	4	68.75	22.500	11.250	32.95	104.55	50	100
	1	29	65.66	20.792	3.861	57.75	73.56	48	110
	2	7	61.14	15.302	5.784	46.99	75.29	50	90
	Total	40	65.18	19.742	3.121	58.86	71.49	48	110

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PREKYPHO	Between Groups	137.868	2	68.934	.950	.396
	Within Groups	2684.507	37	72.554		
	Total	2822.375	39			
POSTKYPHOTIC	Between Groups	18.208	2	9.104	.298	.744
	Within Groups	1130.892	37	30.565		
	Total	1149.100	39			
FOL KYPHOTIC	Between Groups	22.910	2	11.455	.254	.777
	Within Groups	1666.690	37	45.046		
	Total	1689.600	39			
TRANSPRE	Between Groups	83.670	2	41.835	2.203	.125
	Within Groups	702.730	37	18.993		
	Total	786.400	39			
TRANSPOST	Between Groups	4.285	2	2.143	.646	.530
	Within Groups	122.690	37	3.316		
	Total	126.975	39			
REHABFIM	Between Groups	153.018	2	76.509	.210	.812
	Within Groups	13510.957	37	365.161		
	Total	13663.975	39			
FINFIM	Between Groups	55.107	2	27.553	.110	.896
	Within Groups	9290.868	37	251.105		
	Total	9345.975	39			
POSTFIM	Between Groups	171.616	2	85.808	.211	.811
	Within Groups	15028.159	37	406.166		
	Total	15199.775	39			

```
CROSSTABS
  /TABLES=tliss aocode deniscod  BY tysurco
  /FORMAT= AVALUE TABLES
  /STATISTIC=CHISQ
  /CELLS= COUNT COLUMN .
```

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
TLISS * TYSURCO	40	100.0%	0	.0%	40	100.0%
AOCODE * TYSURCO	40	100.0%	0	.0%	40	100.0%
DENISCODE * TYSURCO	40	100.0%	0	.0%	40	100.0%

TLISS * TYSURCO

Crosstab

			TYSURCO			Total
			1	2	3	
TLISS	7	Count	2		5	7
		% within TYSURCO	50.0%		20.8%	17.5%
	9	Count	1	10	13	24
		% within TYSURCO	25.0%	83.3%	54.2%	60.0%
	10	Count	1	2	6	9
		% within TYSURCO	25.0%	16.7%	25.0%	22.5%
Total		Count	4	12	24	40
		% within TYSURCO	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.968[a]	4	.138
Likelihood Ratio	8.377	4	.079
Linear-by-Linear Association	.134	1	.714
N of Valid Cases	40		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .70.

AOCODE * TYSURCO

Crosstab

			TYSURCO			Total
			1	2	3	
AOCODE	1	Count	1	5	9	15
		% within TYSURCO	25.0%	41.7%	37.5%	37.5%
	2	Count	3	6	15	24
		% within TYSURCO	75.0%	50.0%	62.5%	60.0%
	3	Count		1		1
		% within TYSURCO		8.3%		2.5%
Total		Count	4	12	24	40
		% within TYSURCO	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.931[a]	4	.570
Likelihood Ratio	3.026	4	.553
Linear-by-Linear Association	.195	1	.659
N of Valid Cases	40		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .10.

DENISCODE * TYSURCO

Crosstab

			TYSURCO			Total
			1	2	3	
DENISCODE	1	Count	1	3	8	12
		% within TYSURCO	25.0%	25.0%	33.3%	30.0%
	2	Count	3	3	13	19
		% within TYSURCO	75.0%	25.0%	54.2%	47.5%
	3	Count		6	3	9
		% within TYSURCO		50.0%	12.5%	22.5%
Total		Count	4	12	24	40
		% within TYSURCO	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.363[a]	4	.079
Likelihood Ratio	8.587	4	.072
Linear-by-Linear Association	.652	1	.419
N of Valid Cases	40		

a. 5 cells (55.6%) have expected count less than 5. The minimum expected count is .90.

ANNEXURE I

EVALUATION OF SURGICAL TREATMENT OF FLEXION DISTRACTION INJURY OF THORACOLUMBAR SPINE FRACTURES 2000-2006

1 NAME:

2 AGE:

3 SEX:

4 HOSPITTAL NO:

5 ADDRESS:

6 MARRIED:

7 FAMILY:

8 EDUCATION:

9 OCCUPATION:

10 INCOME:

11 FINAL DIAGNOSIS:

12 MODE OF INJURY:

13 TIME OF INJURY:

14 CASUALITY ADMISSION TO SURGERY:

15 STEROID THERAPY :

16 GCS:

17 AIRWAY:

18 BREATHING; RR:

19 CIRCULATION; PR: BP: SHOCK: FLUID THERAPY: BLOOD

20 SHOCK:

21 SKELETAL EXAMINATION:

22 C-SPINE:

23 CLAVICLE

24 RT--

25 LT--

26 UL--

27 LL--

28 RT-

29 LT

30 THORAX--

31 PELVIS--

32 THORACO LUMBAR SPINE:

33 LEVEL

34 CONTUSIONS

35 ABRASIOINS

36 LACERATIONS

37 DEFORMITY

38 HEMATOMA

39 INTERSPINOUS GAP

40 NEUROLOGICAL EXAM:

41 LAST INTACT SENSORY:

42 LAST INTACT MOTOR:

43 DTR

44 KNEE

45 ANKLE

46 PLANTAR

47 PERIPHERAL SENSATION

48 ANAL WINK

49 VAC

50 BULBOCAVERNOUS REFLEX

51 FRENKEL GRADING

GR-A ABSENT MOTOR AND SENSORY

GR-B SENSATION PRESENT MOTOR ABSENT

GR-C SENSATION PRESENT ,MOTOR ACTIVE BUT NOT USEFUL

GR-D SENSATION PRESENT MOTOR ACTIVE AND USEFUL

GR-E NORMAL MOTOR AND SENSORY

52. ASIA SCORE

53. X-RAY DL SPINE

VERTEBRAE INVOLVED

AP

LATERAL

TRANSVERSE PROCESS

BODY HEIGHT

SPINOUS PROCESSESS

UPPER END PLATE

PEDICLES

LOWERENDPLATE

INTERPEDICLE DISTANCE

IV DISC

LAMINA

BODY

UPPER THIRD

MIDDLE THIRD

LOWER THIRD

TOTAL BODY

TRANSLATION

SPINOUS PROCESSES

INTERSPINOUS DISTANCE WIDENED -----Y/N

KYPHOSIS ANGLE

54. CT

55. DENNIS CLASSIFICATION:

ANTERIOR

MIDDLE

POSTERIOR

1.COMPRESSION

ANTERIOR

LATERAL

2.BURST

A-AXIAL LOAD

B-AXIAL LOAD +FLEXION

C-AXIAL LOAD +FLEXION

D-AXIAL LOAD +ROTATION

E-AXIAL LOAD +LATERAL FLEXION

3.FLEXION DISTRACTION :

(SEAT BELT)

4.TRANSLATIONAL INJURY:

FLEXION ROTATION

SHEAR

FLEXION DISTARCTION

56. AO

B1

B2

C2

A.COMPRESSION

1.IMPACTION(WEDGE)

2.SPLIT(CORONAL)

3.BURST(COMPLETE)

B.DISTRACTION

1.THROUGH THE POSTERIOR SOFT TISSUES (SUBLUXATION)

2.THROUGH THE POSTERIOR ARCH(CHANCE FRACTURE)

3.THROUGH THE ANTERIOR DISC (EXTENSION SPONDYLOLYSIS)

C.MULTI DIRECTIONAL WITH TRANSLATION

1.ANTEROPOSTERIOR(DISOCATION)

2.LATERAL(LATERAL SHEAR)

3.ROTATIONAL(ROTATIONAL BURST)

57. TLICS

MORPHOLOGY

PLC

NEUROLOGY

58. ASIA IMPAIREMENT GRADE

59. SURGICAL TREATMENT

60. POSTERIOR APPROACH

61. EXTENDED POSTERIOR APPROACH

62. POSTERIOR PROCEED ANTERIOR APPROACH

63. ANTERIOR APPROACH

64. OTHER SURGICAL PROCEDURES

65. BLOOD LOSS

66. TYPE OF IMPLANT USED

67. LEVEL OF FIXATION

68. POST OP PERIOD

69. WOUND HEALING

70. INFECTION

SUPERFICIAL

DEEP

ORGANISM

ANTIBIOTIC AND DURATION

71. POST OP X-RAY

KYPHOSIS CORRECTION

TRANSLATION CORRECTION

OTHERS

72. NEUROLOGICAL STATUS

MOTOR

SENSORY

BOWEL

BLADDER

STATUS QUO

IMPROVED

73. PMR CONSULTATION

74. REHAB GOALS ACHIEVED

75. FOLLOW UP AT 3 MONTHS

CLINICAL

RADIOLOGICAL

UNION

KYPHOSIS

IMPLANT INTEGRITY

76. FOLLOWUP AT 6 MONTHS

CLINICAL

RADIOLOGICAL

UNION

KYPHOSIS

IMPLANT INTEGRITY

77. FOLLOW UP AT 12 MONTHS

CLINICAL

RADIOLOGICAL

UNION

KYPHOSIS

IMPLANT INTEGRITY

78. FINAL FOLLOW UP

79. MONTHS FROM SURGICAL TREATMENT

CLINICAL

RADIOLOGICAL

UNION

KYPHOSIS

TRANSLATION

IMPLANT INTEGRITY

SOCIAL REHABILITATION

ECONOMIC REHABILITATION

FINAL DIAGNOSIS

FINAL OUT COME

COMBINED SUGERY WITH TITNIUM MESH FOR ANTERIOR COLUMN RECONSTRUCTION

B-LATERAL

B-AP

B-POST-OP LATERAL

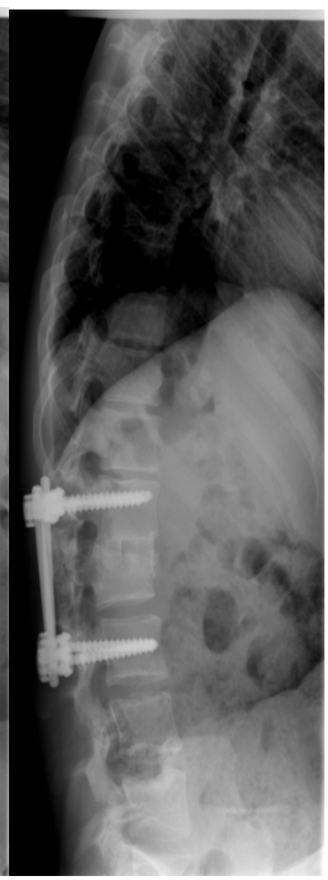
B-POST OP AP VIEW

COMBINED SUGERY WITH TRICORTICAL ILIAC CREST GRAFT
FOR ANTERIOR COLUMN RECONSTRUCTION

AD-LATERAL

AD-PRE-OP AP VIEW

AD-FOLLOW UP



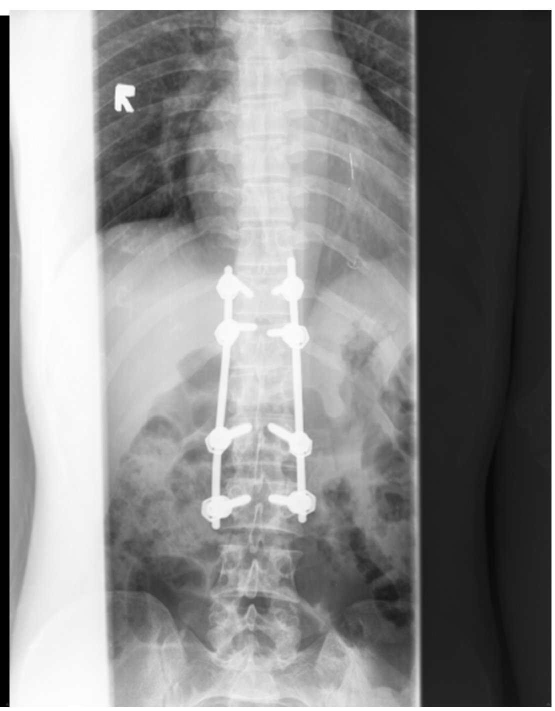
AD-FOLLOW UP LATERAL VIEW

EXTENDED POSTERIOR SURGERY WITH TRICORTICAL ILIAC CREST GRAFT FOR ANTERIOR COLUMN RECONSTRUCTION

GP POST OP

GPPOST-OP

GP FOLLOW-UP



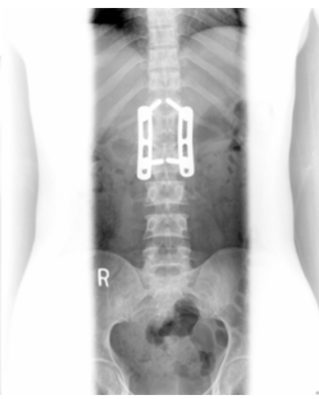
GP FOLLOW-UP(BROKEN IMPLANT)

COMBINED SUGERY WITH TRICORTICAL ILIAC CREST GRAFT
FOR ANTERIOR COLUMN RECONSTRUCTION

KS PRE-OP

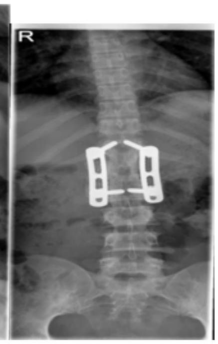
KS PRE-OP

KS-PRE-OP



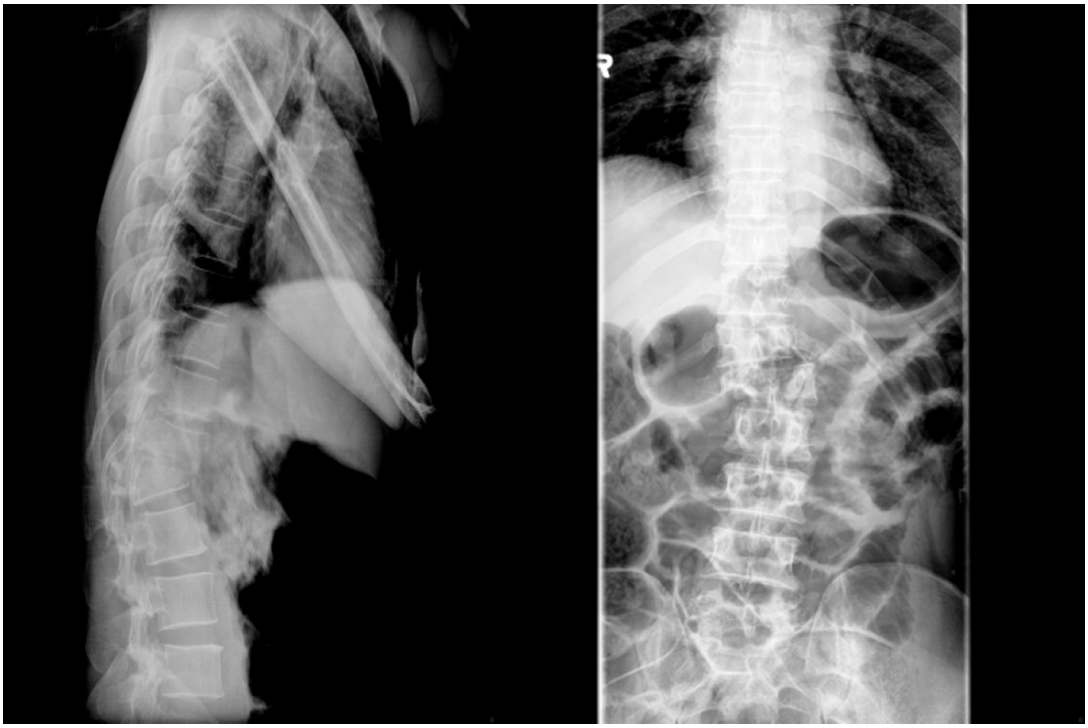
KS POST-OP

KS POST-OP

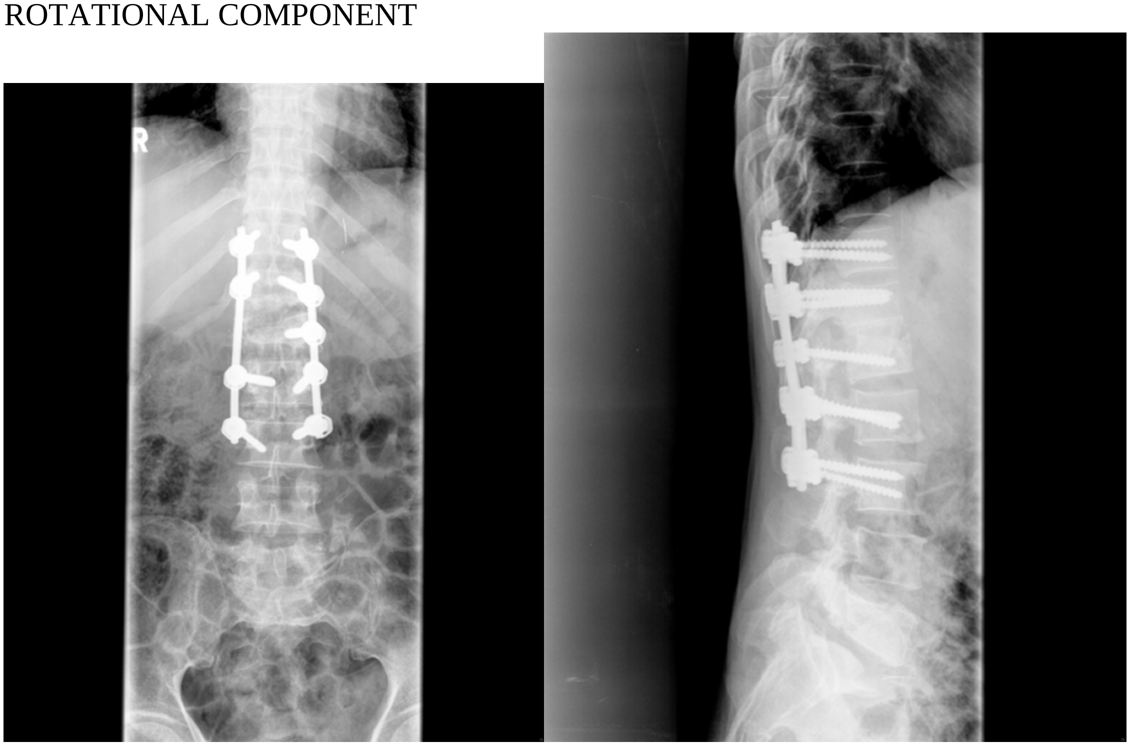


KS FOLLOW-UP

EXTENDED POSTERIOR SURGERY WITH TRICORTICAL ILIAC CREST GRAFT FOR ANTERIOR COLUMN RECONSTRUCTION



ROTATIONAL COMPONENT



ROTATION POST OP

POSTERIOR SURGERY ONLY