Anterior Endoscopic Cervical Discectomy/Foraminoplasty Surgical Technique with Case Illustration

John C Chiu, MD, FRCS (US), DSc
Chief, Neurospine Surgery
California Spine Institute
Thousand Oaks, California, USA
President AAMISMS
California Spine Institute Medical Center, Inc

“Bienvenida del CSI”

Calif. Center for Minimally Invasive Spine Surgery
Overview

1. MISS being disruptive technology with dilatation technology instead of cutting technology

2. To discuss endoscopic cervical decompressive discectomy and foraminoplasty

3. Related non-fusion technique and dilatation technology for preservation of spinal motion

4. MISS with limited visualization needs precise MISS approach

5. The importance having MISS technology, education and training needed for meticulous MISS
Endoscopic Anterior Cervical Discectomy (AECD)

Demographics of Herniated Cervical Discs (3917)

- Since 1995, **2169 patients** with **3917 herniated** cervical discs
- Average age of **43.4** (21 to 82) with symptomatic cervical, single and multiple herniated intervertebral discs
- **Males:** 1109 - **Females:** 1054
- Each **failed** at least 12 weeks of **conservative care**
- Post operative **follow up:** 6 to 75 mos. (average **46.4 months**)
Surgical Indications:

- **Neck with arm pain** (radicular pain) associated with paresthesia, sensory loss, muscle weakness and/or decreased reflexes
- Intractable **cervicogenic headache**
- Discogenic pain
- At least 12 weeks of **failed conservative therapy**
- MRI or CT scan **positive** for disc herniation
- Positive **EMG** considered helpful
- Positive provocative discogram
- **Multiple discs** can be treated at one sitting
- **Post fusion junctional disc herniation** syndrome
- **Positive 3 legs of bar stool** – symptoms, physical findings, EMG, imaging and provocative discogram
Surgical Indications:

In addition, Post Spinal Fusion - Junctional Disc Herniation Syndrome (JDHS), Adjacent Segment Disease (ASD)

- Two post ACF fusion C4-C6 & C5-C6 JDHS cases
- MRI showing junctional discs
- Anterior endoscopic cervical microdiscectomy (AECD) and foraminoplasty provides relief
AECD Surgical Instruments and Equipment:

• Endoscopic surgical instruments for AECD
AECD Surgical Instruments and Equipment:

- Advanced **endoscopic micro flexible forceps**, bone **ronguer** and navigable **dissecting probe**
AECD Surgical Instruments and Equipment:

- Advanced anterior cervical endoscopic instruments

  - For *bony decompression*:
    - Round ball tip drill
    - Sharp drill and trephine
AECD Surgical Instruments and Equipment:

- Anterior cervical endoscopic instruments
  - Discectomes, working channel sets
  - Tri-chip digital camera with cervical 6° endoscope and forceps
  - Endoscopic laser fibers and Instruments

- Holmium YAG laser equipment
- Laser Thermodiskopasty (LTD)
Surgical Procedure/Technique:

• **Instruments for tissue modulation**
• Percutaneous MIST interventional procedures:
  
  – **Injectional**, non ablative and ablative tissue modulation technology, **laser, RF** (radiofrequency), ultrasound, **cryogenic** and others
  
  – **MISS surgeons should be familiar** with injectional and RF facet denervation procedures and others
  
  – **MISS surgeons are uniquely suited to perform** these for the care of the spinal pain
Surgical Procedure/Technique:

Injectional and tissue modulation technology, RF treatment for:

- **Selective nerve blocks**, epidural block and cervical sympathetic nerve block
- **Facet** arthralgia (medial branch of posterior primary rami)
- **Spinal discogenic** pain (related to sinu-vertebral nerve)
- **Cervicogenic** headache
ANESTHESIA – AECD Surgical Technique:

ANESTHESIA and Intra-operative neurophysiological monitoring (IOM)

- Local anesthesia combined with IV conscious sedation with surface EEG monitoring optimize anesthesia and reduce drug requirement.
- The obvious challenge of MISS is limited visualization and exposure of the relevant anatomy and direct visualization of the nerve.
- Continuous intra-operative EMG/neurophysiological monitoring in a digital operating room (DOR) prevents undue neural trauma.
- IOM of neural structure, direct visualization with fluoroscopy and endoscopy creates safer endoscopic MISS procedures.
Intraoperative Neurophysiological Monitoring - IOM

- Trend of spinal surgery is toward less or minimally invasive spine surgery (MISS)
- MISS aims at being less traumatic, with less morbidity and improved surgical outcome
- The obvious challenge of MISS is limited visualization and exposure of the relevant anatomy in spite of fluoroscopy and endoscopy to work with, and potentially placing the relevant neural structures at increased risk of trauma
- INTRAOPERATIVE NEUROPHYSIOLOGICAL MONITORING (IOM) of neural structure, direct visualization with fluoroscopy and endoscopy creates safer endoscopic MISS procedures
- Spontaneous EMG monitoring, at times SSEP and MEP can provide the surgeon with useful feedback to avoid neural trauma during MISS
- Intra-operative surface EEG/neurophysiological monitoring optimizes the anesthesia for MISS
Surgical Technique - Step by Step with Case Illustration
Case Illustration I – Large extruded C6-7 disc:

34 year old accountant suffering from **intractable increasing neck and left arm pain and weakness**. MRI scan showed large C6-7 extruded disc/osteophyte which was relieved by endoscopic cervical discectomy and foraminoplasty.
Endoscopic Anterior Cervical Discectomy (AECD) Surgical Technique:

- **Patient Positioning** and surgical portal of entry
- **Needle and stylette** placement into the disc under Grid Position System (GPS)

- Supine position with hyperextension of neck
- Digital retraction of trachea/esophagus, and the carotid artery under the first two fingers
- Systolic arterial pressure maintained at 130+ ephedrine may be used to maintain BP
- Needle and stylette inserted into the disc aided by GPS, under fluoroscopy and EMG
- **N/G tube** is placed in the esophagus to avoid injury
AECD Surgical Technique:

- **Small** 3mm skin incision
- The **spinal needle with a thin stylette** is introduced into the **center of the disk**
- Under **fluoroscopy**
- Provocative **discogram** is often done first
- The working **cannula/dilator** are passed over the stylette gently (**dilatation technology**)
- **Mechanical microdecompressive discectomy** to follow
- Completed with **laser thermodiskoplasty (LTD)** to shrink and to tighten the disc besides **sinu-vertebral denervation**
AECD Surgical Technique:

Endoscopic/fluoroscopic/imaging monitoring to provide safe and precise application of aggressive micro grasper forceps, drill, curette, discectome, and bony ronguer for microdecompression
Endoscopic Cervical Microdiscectomy and Foraminoplasty Procedure – Step by Step - A

Discogram demonstrated double shadow of large extruded disc/osteophytes

Micro-drill and forceps for microdecompression of disc/osteophyte
Microdecompression along posterior spinal canal with safety ronguer, drill and forceps
Final removal of disc fragments/debris with ronguer, forceps, laser thermodiskoplasty, irrigation and cleaning with a discectome
AECD Surgical Technique:

“Fan Sweep Maneuver”

- For maneuvering instrument to precisely increase the area for microdecompressive discectomy
AECD Surgical Technique:

Endoscopic Microdiscectomy – Laser Thermodiskoplasty (LTD)

- Mechanical *microdecompressive discectomy*
- Herniated disc *fragment removal*
- *Laser Thermodiskoplasty* – disc shrinkage and tightening
AECD Surgical Technique:

Cervical Foraminoplasty
Cervical Foraminal Decompression for Foraminal Disc and Stenosis

- Mechanical decompressive discectomy foraminoplasty for osteophytes/stenosis under fluoroscopy, endoscopy and IOM

Microdiscectomy forceps
Micro cutting forceps
Micro curette

Discectome
Trephine for osteophytectomy
Burr for osteophyte decompression
AECD Surgical Technique:

- Endoscopic views of uncinate joint and nerve root after disc decompression, and fissure in cervical disc

Intra operative endoscopic view of fissure in cervical disc

Uncinate joint and nerve root after endoscopic microdecompression

LTD defect

Fissure

Disc

Uncinate joint
AECD Surgical Technique:

Protocols for laser thermodiskoplasty (LTD)

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<tr>
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Holmium YAG laser with photo thermal effect and mechanism:

- Absorbed by water
- A pear shaped cavitation bubble formed by vaporization of water molecules, undergoes expansion and collapse - resulting in acoustic and shock wave emission
- Simultaneously a vapor channel is formed that effectively conducts laser energy to the target with a pressure effect
- Continuous cold saline irrigation is necessary
AECD Surgical Technique:

Surgical technique of LTD, fan sweep maneuver and endoscopic views of disc shrinkage

- Side fire laser probe in action
- "Fan sweep maneuver" of instrument increased disc removal and shrinkage
- Laser used to shrink and tighten the disc besides "purse string" of the disc defect
AECD Post Operative Care:

- **Ambulatory** usually in about one hour and discharged subsequently
- May **shower** the following day
- May use a **cervical collar** in a vehicle or on a flight as needed
- **Ice pack** is helpful
- **Mild analgesics** and muscle relaxant are required at times
- **Progressive spine exercise** second post operative day on
- Rehabilitation compliments MISS and motion preservation
- Allowed to **return to work** in one to two weeks (not for heavy work)
AECD Surgical Outcome:

- For **2169 patients**, average follow-up 46 months (6-75 months)
- Overall result: 1952(90%) patients with **good to excellent** results, **fair** results 130(6%) patients (single level)
- **Various evaluations/tests** of response to treatment: modified Mac Nab criteria, Oswestry disability score/index (ODI), visual analogue pain scale (VAS), patient satisfaction scoring, pain diagram and/or patient target achievement score (PTA) for assessment **were utilized**
- Average **satisfaction score** – 2309 (94%) patients
- 98 (4.5%) patients had mild residual pain and paraesthesia, although overall their pain lessened
- **Complication rate:** less than 1%
- Average **return to work:** ten days
Case Illustration I –

Octogenarian w/herniated C5-6 disc/osteophyte:

81 yo NS Professor underwent successful laser endoscopic cervical discectomy in spite of transient extreme bradycardia (30), detected, monitored and corrected with atropine in the DOR. Discharged on hour later.

Intra operative monitor shows severe dropping of heart rate.
Case Illustration II – JDHS C3, C4 & C6

- 54 year old female suffering post fusion junctional disc herniation syndrome (JDHS) (after C5 & C6 corpectomy, discectomy and bone graft of C5-C6) at C3, C4 & C6 levels with severe radiculopathy

- Complete relief of spinal symptoms after AECD and foraminoplasty at C3, C4 & C6 level
50 yo female under went successful endoscopic microdecompressive cervical discectomy for a large herniated C5-6 disc.
Case Illustration IV - Large herniated C3-4 disc:

English rock star had **successful endoscopic cervical discectomy C3-4** with **hypoplastic odontoid process**
Case Illustrations V - Large herniated C5-6 disc:

- 44 year old female with increasing intraticable neck and upper extremity pain and numbness of fingers, mild spastic gait and weakness of hand grip, mild hyperreflexia, and hypoesthesia
- **AECM** - post operatively rapid improvement and disappearance of all symptoms

Pre operative MRI scan - Large 5 mm herniated C5-6 disc compressing spinal cord with myelopathic changes of the spinal cord
Case Illustration VI - Large herniated C5-6 disc:

- 35 year old male rock star with increasing intractable neck and upper extremity pain and numbness of fingers, unable to perform
- AECD and left C5-6 foraminal decompressive discectomy and foraminoplasty gave immediate relief of all symptoms

Pre operative MRI scans - Large foraminal herniated C5-6 disc compressing C6 nerve root
Discussion:

- **New biotechnology, instrument advances** and accumulation of endoscopic spinal surgical experience, make the procedure of **AECD** and **foraminal decompression** (foraminoplasty) possible.

- **Open cervical spinal surgery/fusion** results in **higher complication and morbidity** besides longer convalescence.

- Post cervical spinal fusion patient, has high as 25 – 52% of them developed Junctional Disc Herniation Syndrome (**JDHS**) or Adjacent Segmental Disease (**ASD**) within 3-4 years.

- **AECD MISS** is an **effective alternative** or replacement for open spinal surgery for discectomy and decompression of stenosis in degenerative spine disease.
Discussion:

- As demonstrated in a multi-center endoscopic cervical spinal disc surgeries had an overall success rate of 91% (single level)
- With a complication rate of less than 1%, zero mortality, satisfaction score, over 90% (for single and multi-levels)
- Second operation required only in 0.79%
- Resuming usual activity in a few days and full active lives in 2-6 weeks
- These procedures can be extremely gratifying for patients and surgeon
- Soon spinal arthroplasty, spinal motion preservation and dynamic stabilization can become an integral part of all cervical spinal surgery
AECD Discussion:

- In order to perform AECD and to avoid potential complications, one must have a thorough knowledge of laser endoscopic cervical spinal procedures and the surgical anatomy.
- Endoscopic cervical MISS has its unique surgical skill set.
- Requiring the surgeon to go through a steep learning curve.
- Careful patient selection.
- Careful preoperative surgical planning.
- Fluoroscopy as “The 3rd Eye” or “Eye of Wisdom” for confirmation of location of instruments; endoscopy alone is not enough.
- These surgical procedures must be meticulously executed.
POTENTIAL COMPLICATIONS AND THEIR AVOIDANCE

- Excessive sedation:
  - Continuous conscious EEG monitoring with the new computerized SNAP™ monitoring (SNAP index) improves anesthesia and reduces drug requirement
  - Local anesthesia with conscious sedation provides a responsive patient to facilitate endoscopic MISS and prevents potential complications
POTENTIAL COMPLICATIONS AND THEIR AVOIDANCE

• Discitis:
  – Prophylactic antibiotics
  – Continuous irrigation of the interspace
  – Introduction of instruments through a cannula without contact with the skin

• Aseptic discitis:
  – Aim the laser in a “bowtie” fashion to avoid damaging the endplates (at 6 and 12 o’clock)
POTENTIAL COMPLICATIONS AND THEIR AVOIDANCE

- **Spontaneous Cervical Fusion:**
  secondary to using larger working channel, trephine (5mm or more) and trauma to the endplate causes spontaneous fusion at C6-C7
POTENTIAL COMPLICATIONS AND THEIR AVOIDANCE

• Neural Injury: extremely rare
  – No spinal cord injuries reported
  – Nerve root and spinal cord injury, though possible, but avoidable
  – With neurophysiologic monitoring (EMG/NCV)
  – Root injury avoided by introducing instruments in the “safety zone”
  – And direct endoscopic visualization
  – By frequent use C-arm fluoroscopy
  – Recurrent laryngeal nerve injury, is extremely rare
  – Postoperatively one case of transient hoarseness
  – One case with transient hiccough
POTENTIAL COMPLICATIONS AND THEIR AVOIDANCE

• **Sympathetic nerve injury:**
  – Rare but can occur from injury to cervical sympathetic and Stellate Ganglions
  – One post-operative transient Horner syndrome or oculo sympathetic dysfunction occurred

• **Esophageal and trachea injury due to trauma or perforation can occur:**
  – But are avoided by careful surgical technique and by identifying and retracting these structures
  – By careful digital palpation and retraction at the site of needle insertion
  – By placing a nasogastric tube into the esophagus aids in identifying and retracting that structure by palpation.
Conclusion:

- **AECD** has proven to be **safe, less traumatic, easier, and efficacious**
- For treatment of intractable spinal pain secondary to **herniated cervical discs**, and **degenerative cervical spinal disease/foraminal stenosis**
- It **preserves** spinal **segmental motion**, avoids JDHS, and provides an **excellent access** for spinal arthroplasty
- **Utilization of** intraoperative neurophysiological monitoring, **IOM in a DOR prevents neurological injury** and provides a safer **MISS**
- With **proper surgical training** and experience, it is **a smart way** to perform **cervical spinal surgery**
Hope you enjoyed this presentation!

“Gracias por su amable atención”

Thank you
Merci
Danke schön
Arigato
Camón
Gracias

John C. Chiu, M.D., FRSC (US), D.Sc.
California Spine Institute


References


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