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Carbondioxide (CO2) Laser Assisted Microscopic Spinal Surgery For Ablation of Thoraco Lumbar Junction Area Calcified Disc Osteophyte Complex – A Case Report.

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Abstract:
Study Design: *A Case Report*
Objective- *To explain the utilization of CO2 Laser as an excellent and safe surgical instrument in calcified lesions of spine.*
Summary of Background Data- *Among the calcified lesions of spine, disc osteophyte complex is a common pathology. Due to its unyielding nature & constant pressure on neural structures, symptoms are not relieved by nonsurgical means. Pressure may be dynamic with extension also. Symptoms may be relieved with non-surgical means if the herniation is soft but may not be in calcified lesions of spine. This is challenging in upper lumbar levels when the pathology is central to paracentral in location which mandates wide decompression and retraction of thecal sac. There is a need for advancement in surgical technique which is efficient in complete removal of calcified disc and at the same time preserving the structural integrity of spine without the need for retraction of neural structures.*
Material and Methods- *We report a case of calcified disc osteophyte complex at upper lumbar level (L1-2). This lesion was approached by oblique paraspinal approach using tubular retractor system and ablated with CO2 Laser using microscope with special laser delivery connector.*
Results- *Complete removal of disc osteophyte complex was achieved without the need of excessive intraoperative thecal sac retraction.*
Conclusion- *CO2 laser can be used as a noncontact instrument for the ablation of calcified disc osteophyte lesions of thoracolumbar region. Use of CO2 laser eliminates the need for use of drills , triphines and osteotomes for the removal of calcified disc osteophyte complex which otherwise could cause potential iatrogenic post operative neurodeficits.*
Keywords: *calcified lesions of spine, disc osteophyte complex, CO2 Laser*

I. Introduction

Lumbar disc herniation (LDH) is a common disorder among adults with a degenerative spinal change, and has a reported lifetime occurrence as high as 40%[1] . In adolescent disc prolapse, tendency for managing disc prolapse conservatively leads to calcification of disc material in long run and is responsible for late onset of symptoms in adulthood. Symptomatic herniated thoracic discs (HTDs) account for only 0.15–1.8 % of all intervertebral disc abnormalities treated surgically [2,3,4]. Disc herniation occurring at the thoracolumbar junction area (T10/11 to L1/2) may present with neurological deficits, and high rates of disability[5,6,7,8]. Thoracolumbar herniated disc is frequently centrally located[5,7,8,9]. They are known to frequently calcify and present as "hard discs"[5,7,8,9]. Difficult location of calcified lesion mandates extensive open surgical procedure and retraction of neural tissues leading to the newer onset neurodeficits postoperatively. Various surgical procedures have been explained to treat calcified lesions[10,11]. In this era of minimally invasive spinal surgical techniques, such extensive open surgical procedures should be used in very selected cases. Tools for precise excision of calcified lesions from difficult areas of spine should be invented which limits retraction of neural tissues and can be used through limited surgical exposure.

Studies on the effects of CO2 lasers on the nervous system has made dramatic progress in delivery systems technology[12]. With continuous growth of knowledge of laser-tissue interaction effects and hazards, applications of CO2 Laser in Spinal microsurgery are expanding rapidly. Haemostasis, cutting and vaporization depends on laser emission parameters like wavelength and mode of laser beam used. It also depends upon the exposed tissues optical and thermal properties, water and haemoglobin content, thermal conductivity and specific heat[12].

CO2 laser is known for its haemostasis, dissection and tissue vaporization properties. It is accurate with depth of penetration less than 50 um and thermal effects at the depth less than 200 um . It is having excellent tissue ablative properties with minimal lateral tissue damage[13]. These properties make CO2 Laser as non-contact instrument which reduce surgical trauma to the spinal cord and nerves without the need to use bigger surgical instruments like drills, trephines or osteotome in the vicinity of delicate neural tissues in cases of calcified lesions of spine. Current applications of lasers in spinal microsurgery include soft disc herniations, spinal cord meningiomas, spinal cord neuromas & metastasis. It has been used in posterior cervical microscopic foraminotomy and discectomy[14], recurrent lumbar disc herniations[15], extraforaminal lumbar disc herniations[16], ablation of lumbar discal cyst[17] , removal of anterior cervical disc osteophyte complex & removal of epidural fibrosis but none has described its utilisation in calcified lesions of spine. In this case report Authors have described case of calcified lesion at upper lumbar level and its management with CO2 laser assisted Microscopic surgery.

II. Case Report

38 Old female patient presented with pain (VAS 9) in left lower limb with radiation along lateral surface of leg since 3 months. She had tingling in the sole of left foot. There were no neurodeficits and bladder-bowel complaints. No instability noted on dynamic X Ray. MRI of lumbar spine showed compressive lesion from left central to subarticular region at L1-2, causing lateral recess stenosis & thecal sac compression and was found to be calcified on CT scan (Fig.1). Myelogram showed filling defect at L1-2 level (Fig.2). No other lesions noted on screening of whole spine. Diagnostic block at L1-2 was positive. She had no relief with conservative treatment.

Patient was operated under general anesthesia in prone position on wilsons frame. Zeiss OPMI Vario S 88 surgical microscope with special joy stick for the control of laser beam direction and spot size of laser is used. “Special” connector for CO2 laser delivery form CO2 Laser machine (Sharplan 30C, Lumenis, Yokneam, Israel) to microscope is used (Fig. 3). Oblique paraspinal approach was used as the compressive lesion was central to paracentral in location. Incision of 22 mm taken 6 cm away from midline (Fig.4). Subcutaneous tissue and dorsolumbar fascia incised. 18 G spinal needle inserted through incision under C-arm guidance targeting mid pedicular line on AP view and posterior vertebral line on Lateral view(Fig. 7 a,b). Guide wire of 1.8 mm passed through needle. Serial dilators passed over guide wire and 20 mm tube retractor inserted and fixed insitu (Fig.5). Final position of retractor was confirmed under C-arm (Fig. 7 c,d).We used Metrx tubular retractor system (Medtronic Sofamor Danek, Inc., Memphis, TN). Further procedure was carried out under microscope. Intervening muscle was removed with bovie cautery. Tip of Superior articular process of L2 & isthmic flare of L1 was drilled out; foraminal ligament removed. Retractor was directed more medially and access to intracanalicular area at L1-2 level was gained.

Dural sac with exiting L1 nerve root identified. With minimal retraction of dural sac and exiting nerve root with compressive pathology was identified. Epidural vessels cauterised & Calcified lesion was ablated (Fig. 6 a)with continuous wave CO2 laser. Spot diameter of 0.3 mm used at 300 J of energy & power setting of 10 W. Intermittent irrigation was used . With changing angulation of microscope more medially and keeping retraction of dural sac to minimum ablation of paracentral lesion was achieved precisely and completely(Fig.6 b). Final confirmation of complete decompression was done with probe.

Leg pain reduced postoperatively. VAS score for leg pain dropped from preop 9 to postop score of 2. Patient was ambulated on next day of surgery. No fresh neurological complaints observed postoperatively. There was evidence of complete removal of compressive lesion on post operative MRI and CT scan (Fig.8)

III. Results

Complete removal of disc osteophyte lesion was achieved without the need for excessive intraoperative thecal sac retraction. No fresh neurodeficits were observed postoperatively due to limited thecal sac retraction.

IV. Discussion

In the case mentioned here, Radiological evaluation of patient revealed the presence of calcified lesion at L1-2 from central to foraminal area compressing thecal sac. This level is dangerous due to the presence of conus and cauda equina densely packed in a narrow canal. In order to remove central calcified disc osteophyte complex along with paracentral lesion, greater retraction of neural tissues is required. Dense fibrous adhesions are expected between the calcified disc and ventral aspect of thecal sac in this case owing to its chronicity. Microdecompression of this area is considered extremely difficult and sometimes results in postoperative dysestheisas or temporary weakness in lower limbs. Also in order to prevent excessive retraction of neural tissues and to make room for the play of bigger surgical instruments like drills, trephines or microcurrets, removal of more than half of the facet joint is required which may result in postoperative back pain or instability & subsequently requires fusion surgery. Calcifications around the recurrent disc fragments are often seen, which may also hinder the surgeons ability to dissect safely. But with the aid of a CO2 laser, surgeons could evaporate the calcified portion of the disc without excessive retraction of the nerve root via a narrow operative corridor[18]. Moreover, with a slight gentle retraction of the nerve root, surgeons could easily access the narrow ventral part of nerve root using CO laser, where a scalpel could not access. In spine surgery, laser has advantages over scalpel use in terms of precision; the ability to be used on delicate tissues; minimal tissue manipulation; as well as less bleeding, swelling, and trauma[19]. It is especially useful in the small spaces involved in herniated discs[17]. The use of CO2 laser-assisted lumbar microdiscectomy for intracanalicular disc herniation has been previously described[19-22] but no one described exclusive use of CO2 lasers for the ablation of calcified disc osteophyte complex. CO2 laser influences negatively bone regeneration by decreasing the osteoplastic activity[23]. Moreover, use of burr intraoperatively for osteophyte drilling sheds the fine metal dust to the surroundings which leads to the post operative MRI artifacts at that region. To authors knowledge, this is the first case report mentioning use of CO2 laser in calcified disc osteophyte complex at thoracolumbar region of spine.

V. Conclusion

CO2 laser can be used as a noncontact instrument for the ablation of calcified disc osteophyte lesions of thoracolumbar region. It eliminates the need for use of surgical instruments like drills, osteotomes and trephines for the removal of disc osteophyte complex which otherwise could cause potential iatrogenic post operative neurodeficits.

VI. Summary

In this example CO2 laser was used for ablation of central to paracentrally located disc osteophyte complex form L1-2 level. "Special" CO2 delivery connector was used attached to the microscope. Oblique paraspinal approach was preferred and L1-2 level was exposed with the help of tubular retractors. With very minimal retraction of neural tissues, complete ablation of calcified compressive lesion was achieved. Postoperatively decompression of canal was confirmed by symptom relief and documentation of total removal of disc osteophyte lesion on CT and MRI scan. CO2 laser is an excellent non contact tool which should be used in calcified lesions of difficult areas of spine where otherwise the use of bigger surgical instruments would cause neurological damage.

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Author Disclosures-
No conflict of interest. No disclosures.
Figure Legends-
Fig.1 – T2W MRI lumbar spine a. Sag and b. Axial. Note Compressive lesion from left central to subarticular region at L1-2 causing lateral recess stenosis & thecal sac compression. c & d. calcified hard disc osteophyte complex confirmed on CT scan.
Fig.2- Pre operative MR Myelogram a. Coronal b. Left oblique. Note filling defect on left side at L1-2 level.
Fig.3 Microscope on right with special joystick (Red arrow) CO2 Laser machine kept on the left (Black arrow). Note laser beam delivery Connector (yellow arrow) attaching microscope with laser machine.
Fig.4- Incision (22 mm) taken 6 cm away from the midline on left paraspinal area.
Fig.5- Metrx Tubular retractor insitu.
Fig.6-a. Thecal sac retracted at 12’0 clock position with suction tip; exiting nerve root from 8 to 5 ‘0 clock position retracted with retractor. Red dot indicates laser beam ablating calcified lesion, b. showing complete ablation of calcified lesion(white coloured). Medial angulation of microscope helps in ablation of more medial lesion. Note the retraction of thecal sac was kept to minimal.
Fig.7- a. C-arm AP view, tip of needle at Mid pedicular line, b. C-arm LAT view, Tip of needle on the line of posterior vertebral wall, c. C-arm AP view, position of sequential dilators with tube retractor over the guide wire, d. C-am LAT view, position of sequential dilators and tube retractor over guide wire.
Fig.8- a. Post operative T2W MRI Scan; Sag image showing no indentation over thecal sac & b. Axial image showing decompressed central canal, lateral recess. C &d . confirmation of complete removal of disc osteophte complex on CT scan.

Fig. 8 b

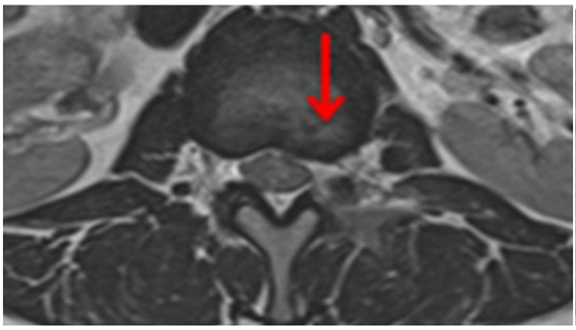
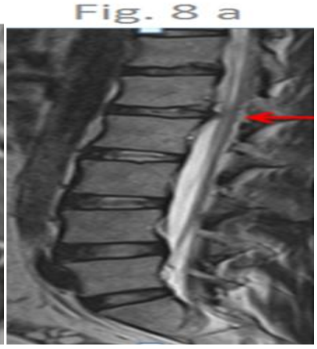


Fig. 8 a



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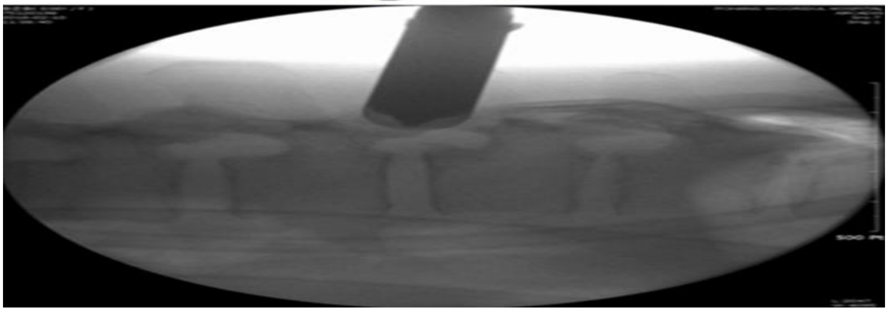
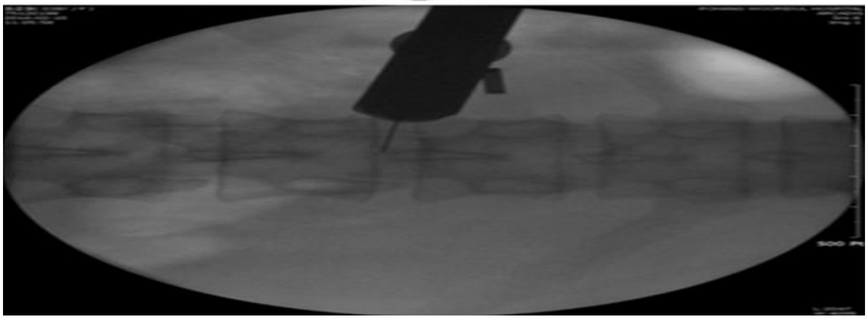


Fig. 7 c



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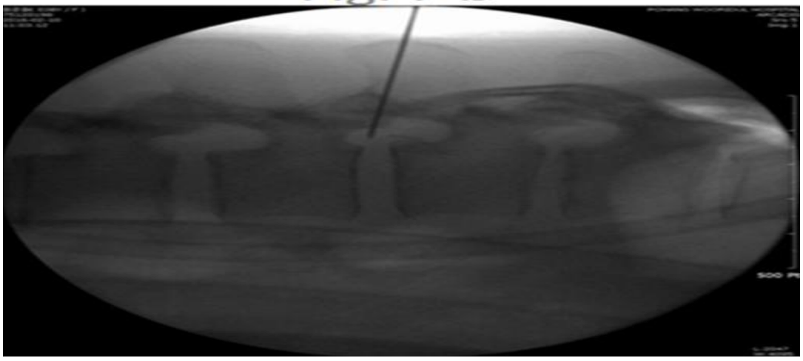

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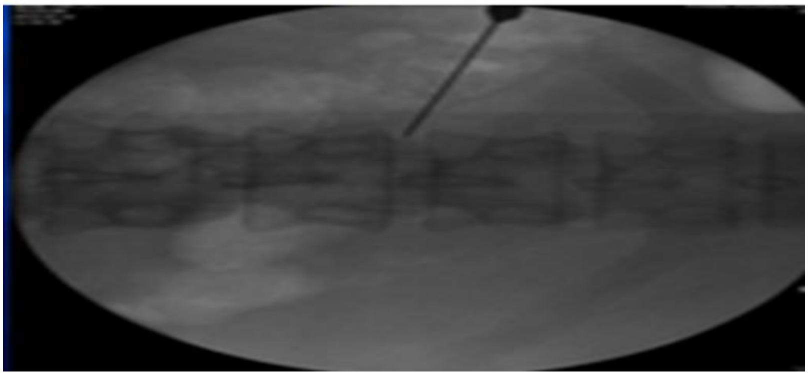

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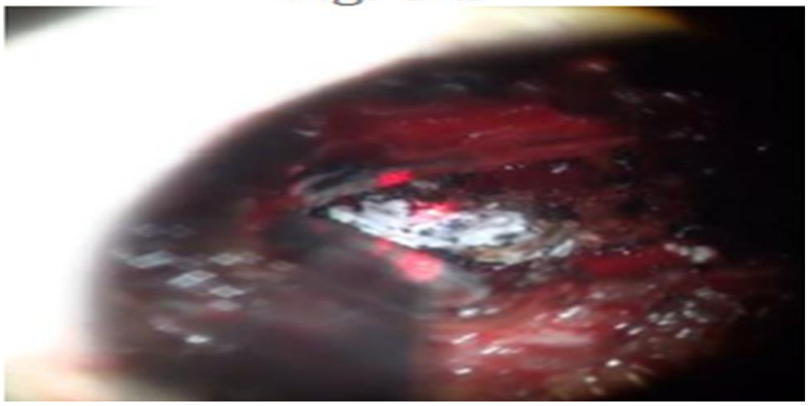

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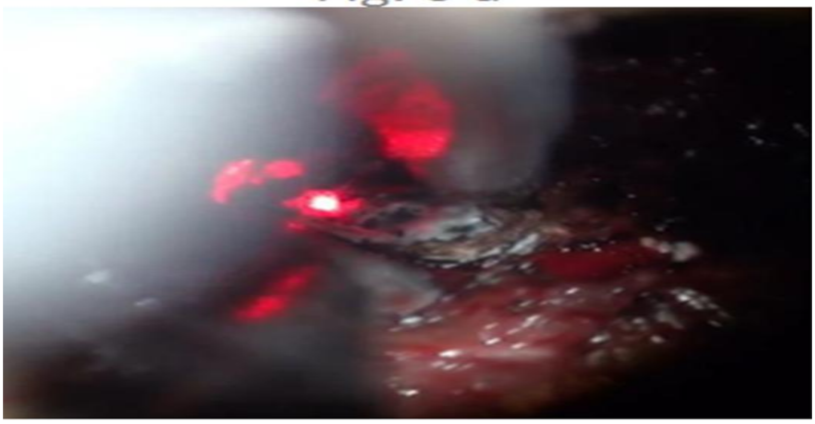


Fig. 4

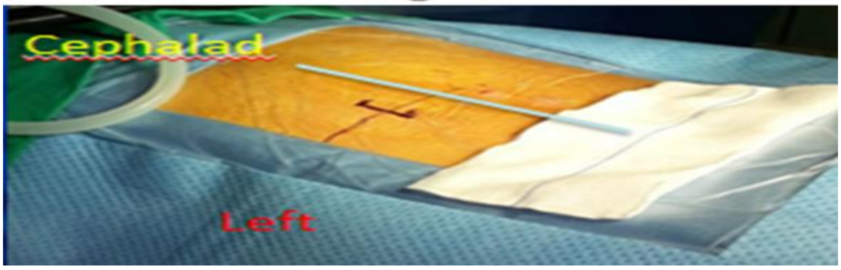


Fig. 5

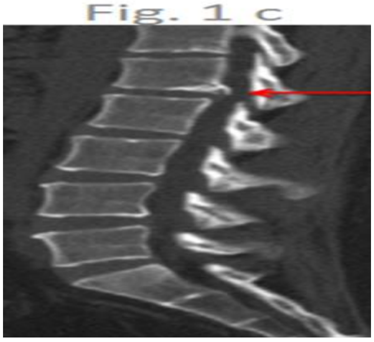
Fig. 3

Fig. 2 b

Fig. 2 a

Fig. 1 d

Fig. 1 c



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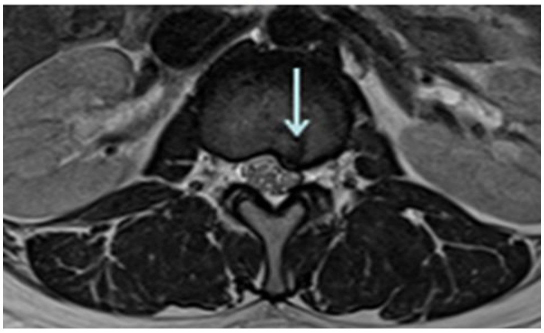

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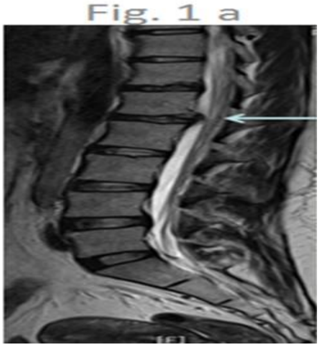

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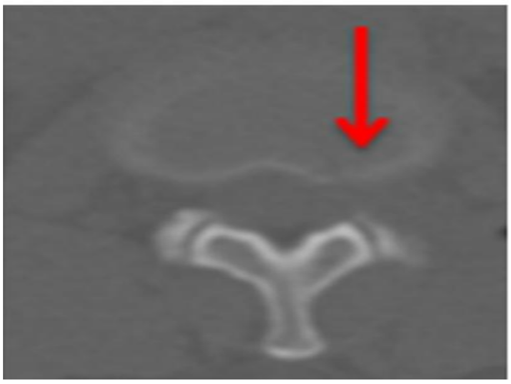

Fig. 8 c