出國報告（進修）

美國邁阿密大學神經外科
Neurological Surgery, Miller School of Medicine, University of Miami, Miami, FL, USA

①

服務機關：臺北榮民總醫院神經醫學中心神經外科
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派赴國家：美國
進修期間：2016/02/15 -2017/07/25

摘要（含關鍵字）

以下介紹我至邁阿密大學醫學院神經外科進修微創及新式脊椎手術的過程及心得。在去邁阿密大學前我在台灣的國際會議認識了後來美國的老闆: Professor Michael Wang. Michael 是美籍華人，在美國出生長大，現在是美國神外醫學會 spine section 的主席，也是神外最好期刊 Journal of Neurosurgery: Spine 的總編之一。在台灣的時候就聽過 Michael 的演講，知道他在 minimally invasive spine surgery 跟 adult deformity surgery 是美國數一數二的權威，不論是臨床手術和學術上，都有很值得我學習的地方。到美國佛州邁阿密大學進修了一年的脊椎側彎和微創手術，更見識了 Michael 獨到的內視鏡腰椎融合手術，在邁阿密有很大的收穫，無論是在手術上或論文寫作上。在邁阿密我認識了來參觀的史丹福大學的醫師，與他成為了好友，他也熱情邀請我去史丹福大學，這個號稱美國西岸的麻省理工學院的地方學習，它們有很多的作法與邁阿密不同，但是治療病人有很好的效果，同時他們也在試著進行用幹細胞修復中樞神經的治療跟手術，這一點與本科進行的用生長激素做神經修復的治療有互補的效果，在 Michael 的鼓勵之下，也短暫去了加州做了訪問之旅。

Keyword: minimally invasive spine surgery, adult deformity spine

目錄

一、 目的

在台灣的脊椎手術，台北榮總向來是處於一個領先的地位，我們在頸椎手術和人工椎間盤的手術，發展得相當全面和進步。腰椎退化和側彎的疾病，病患數量和需求又比頸椎來的更大。腰椎的微創手術在敝科老師的努力開闢之下，已經有很新的進展，但是在某些手術術式上，因為器械的限制，我們還落後美國一些。近年來新式器械的引進，讓 spine surgeon 在微創手術和側彎手術上有更多的手術方式跟傷害性更小的選擇。這些新的器械和新的術式在美國發展了好幾年，已經進展得相當成熟了，邁阿密大學的 Michael Wang 教授的，也就是我的指導老師，更是其中的先驅跟佼佼者，連美國很多 spine surgeon 都暱稱他是 King of MIS (minimally invasive surgery)。有幸在一次國際會議中與 Michael 認識，他與科內的老師們也算相熟，在徵得 Michael 同意後，我就在 2016 年的 2 月踏上了遠在地球另一端的旅程。

二、 過程

人生第一次到有名的觀光聖地邁阿密就坐了十六個小時的飛機，真的是非常的遙遠，我們國家的長榮航空還不錯，但美國國內線的品質真的是比廉航好不到哪去。不過邁阿密大學真的不愧是世界知名的大學，非常的漂亮，有很多有名的景點、學院和設備，校園也都蓋得非常大。邁阿密的海灘非常有名，天氣像台灣一樣熱，到當地的第一天，很幸運有一個認識的北榮同事比我早去半年，有他帶我到處先晃來晃去，幫我找房子住，真的省下我不少時間而且方便很多。

我與我太太就住在市中心的附近，離學校約十分鐘的車程，邁阿密的房屋租金算偏高的，我們租了一個靠海邊的公寓，雖然比較貴但治安比較好，有一個很漂亮的海景，事後想想還蠻開心有住在一個有海景的公寓，以後這輩子大概也沒有這樣的機會了。安頓好後就開始臨床的進修，大學神外的秘書是個年輕人，很好講話，也很幫忙，而且有同事的帶領所以很快就上手了。進修以門診跟手術為主，門診是每個禮拜一，需要幫教授口述病人的病歷，這一開始是個蠻大的問題，你需要把病人的病歷整理完唸出來交給專人打字，還好過一陣子就習慣了。手術室裡的設備跟人員都非常好，典型的美國醫院，幾乎甚麼都是最新的。人員配置的數量非常充分，有很多的幫手，每項工作都有專門的人員負責。Michael 帶我熟悉了手術室的環境後，每天的最主要重點就是看他的手術如何進行，跟我們有甚麼差別，我們該如何改進，有哪些新的手術或我們沒有在做的手術該怎麼做，等等。門診跟手術之餘，還要幫 Michael 整理病人的資料，Michael 也給了我們很多寫 paper 跟 textbook 的題目，我在美國的期間，

也幫他完成了不少 textbook chapter 跟一些 research paper。

除了醫院的事情，Michael 在生活上也很照顧我，三不五時找我去聚餐，Thanksgiving 跟 Halloween 都會請我去他家的 party。Michael 有一艘遊艇，常常帶我們去出海，還帶我去玩實彈射擊，因為他有收集槍的嗜好。

閒暇之餘當然是去參觀美國各大城市及風景，趁機去多參加他們的學術會議，邁阿密也是個很漂亮的城市，可惜只在那裏待一年多，沒辦法多多享受美國式的生活。但到邁阿密進修一年多，還是有很多的收穫，希望可以在台灣好好應用。

二、 心得

剛開始去邁阿密，生活適應上真是一個大問題，邁阿密的華人很少，甚至亞洲人也很少，要買亞洲的東西相當不方便，亞洲食物也很少，亞洲餐廳也不多，但是很令我驚訝的，其實很多還蠻道地和好吃，只是選擇不多。邁阿密氣候很好，常常陽光普照，不冷也不熱，居住起來很舒服。

美國手術房的內部真的相當好，不管是從硬體設施還是軟體，醫師的水準，都讓我見識到美國果然是一個第一世界的先進國家。邁阿密大學應該算是南佛州最大 center，每年有全世界各地醫師來進修，南美洲的醫師最多，因為這裡很多南美洲的移民，是美國離南美洲最近的城市，科內也有很多討論和研究會議，會議中除了聽來自世界各地的專家和醫師分享自己的經驗之外，更重要的是有機會可以在會中及會後直接面對面互相交流討，甚至相談甚歡的話，還可能再進一步一起中午用餐聊天，多了解真正對方的手術精隨。這次會議中遇到了許多科內的專家及醫師，順便了解各國對於脊椎疾病的治療、病人的狀況、醫材的使用狀況是否與台灣的狀況相同，其實台灣的技術跟其他國家比起來，其實並不遜色，但是就在健保的限制之下，很多新式的醫材跟器械都沒有，所以很多手術我們無法推進，廠商也不願意進駐台灣這個限制很多又小的市場，這真的是很可惜，台灣的病人無法接受到最新的治療，或許病人本身並不知道，但是我們醫療提供者就知道這真的是健保制度下最令人感到扼腕之處。出國進修，一方面學習新知之外，一方面也可以確認自己知道目前已知最好的治療，幫自己手上的病患尋求最好的治療，雖然很多東西台灣都沒有，我們還有很大的努力空間。另外我覺得也很重要的是，藉由出國，有了與國外大師交流的機會，對以後的研究和進修更好的技術有很大的幫助。另外最好的地方是美國常常都有很多的 workshop 可以去參加，雖然價錢都很貴，要一兩千美金，但是這是台灣很少有機會可以參加的，而且有時跟著他們的主治醫師或住院醫師一起去，常常都可以不用付錢，另外台灣的大體規定比較嚴格，要請到外國教授來教也比較不容易，所以這是進修的最大好處之一。

在美國進修可以多去參加他們的學術會議也讓我收穫很多。可能從小的教育方

式，美國人在開會中真的很會演講，討論的內容也都是有憑有據，可以在會議中獲得很多第一手的資訊跟現在大家最新最有共識的觀念，我的感想的是他們的平均水準還領先我們五到十年，雖然某些部分台灣也有世界級的成果，但整體來說我們還有努力追趕的空間。

美國的生活也給了我很多的思考，如何在追求自己的目標中前進，在台灣我們常常都走在別人鋪好的道路上，以為應該都要跟老師們一樣才對，但是去了好幾家醫院進修，讓我知道應該做的是好好思考自己的目標，而不是一味走別人走過的路。

四、 建議事項（包括改進作法）

其實是很感謝榮總可以出公費讓我們去出國進修，可以說是幫助很大，不然出國都要花很大一筆錢，尤其美國消費其實很高，至少可以補助一些花費。但是不得不說，美國在消費水平上這十年來增加很多，尤其是像邁阿密、紐約、舊金山、洛杉磯這樣的一線城市，所以補助的金額其實有點過時了，我也了解經費得來不易，但若可以參考當地的物價水平會更好。

以脊椎手術的進行來說，其實除了外科醫生和刷手護士之外，其他的技術人員也是很重要的一環，尤其是放射技術員，不論脊椎手術的科技多進步，引入再多的導航或機器人手臂系統，術中照相仍然是很基礎重要的一步。在邁阿密大學醫院的手術房裡面，配備有數個專門只照 C arm 或相關術中照相的技術員，純熟的技術員可以節省很多手術的時間，對開刀房人員跟病患都可以降低放射線量。如果可以新增專門的術中放射師，對手術的進行跟安全是有幫助的。

在美國我看到他們的人員運用上，每個人的職務跟工作內容是非常明確且專一的，每個人不需要身兼多項任務，基本上就是做好自己分內的事，整個系統就可以運作順暢。舉例來說，開刀房刷手護士就是只負責上刀，不會有上刀以外的任務，我認為開刀過程應該是一個高效運轉的狀態，就像一場小型交響樂，刷手護士沒有雜務，才能專注在手術當中，和外科醫師做很好的搭配，讓手術快速又安全的進行，而且現在的手術器械和科技都越來越複雜，沒有專注很難能熟悉新科技。如果一個交響樂團的小提琴手，演奏前還要管燈光，排椅子，我們可能也會很訝異他能否專心在演奏及配合指揮。

五、附錄: 出國報告圖片和 PDF 檔

JNS JOURNAL OF NEUROSURGERY
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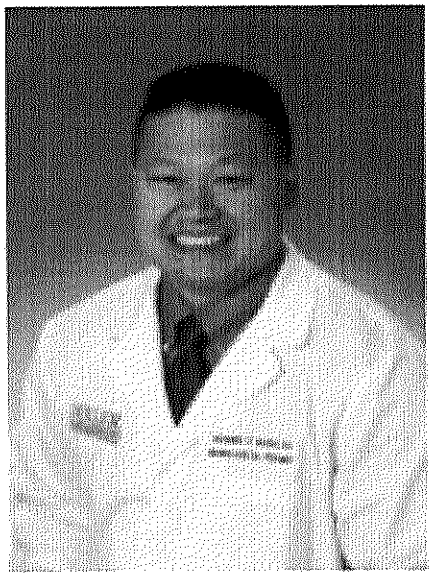


Michael Wang, MD *Co-Chairman*

Dr. Wang was born in Scottsdale, Arizona an
Atlanta, Georgia. He then attended Stanford
California where received both his B.S. and M
his residency at the University of Southern C
Hospital and went on to become the Spine P
Fellowship Director at the USC. In 2007 he m
currently serves as a Professor in the Depart
Surgery and Rehabilitation Medicine at the U
School of Medicine.

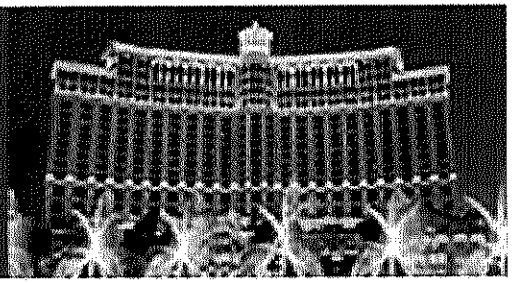
Dr. Wang's research and clinical interests include minimally invasive sp
surgery, spinal deformity, clinical outcomes and trials, and spinal cord in

17年1月1日 星期日

The International Society for the Advancement of Spine Surgery

ISASS16

April 6-8, 2016 · Las Vegas, NV USA



Scientific Program

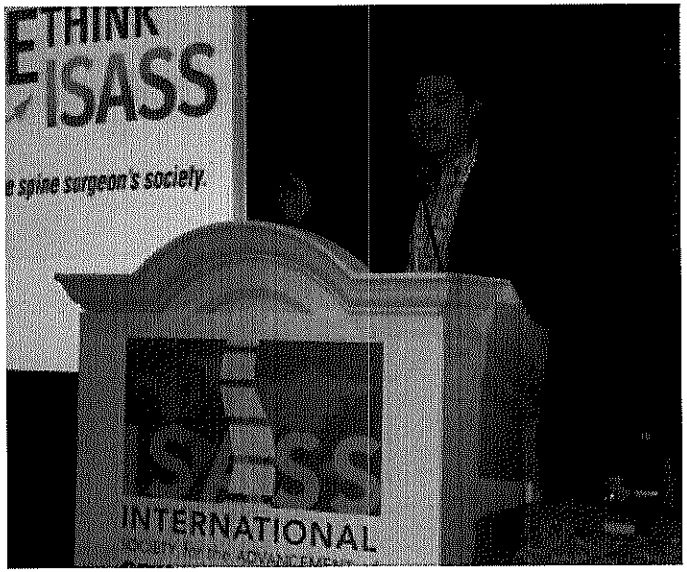
9:45 am - 9:49 am

336 **Should Cervical Disc Arthroplasty be done on Patients with Increased Intramedullary Signal Intensity on Magnetic Resonance Imaging?**

Speaker: H-K. Chang

Authors: H-K. Chang(1,2), J-C. Wu(1,2), P-Y. Chang(1,2), T-H. Tu(1,2), L-Y. Fay(1,2), W-C. Huang(1,2), H-C. Chang(3), H. Cheng(1,2)

(1)Taipei Veterans General Hospital, Neurological Institute, Taipei, Taiwan, Republic of China, (2)National Yang-Ming University, School of Medicine, Taipei, Taiwan, Republic of China, (3)Kaohsiung Veterans General Hospital, Surgery, Kaohsiung, Taiwan, Republic of China



ORIGINAL ARTICLE

Should Cervical Disc Arthroplasty Be Done on Patients with Increased Intramedullary Signal Intensity on Magnetic Resonance Imaging?

Hsuan-Kan Chang[1,2], Wen-Cheng Huang[1,2], Jau-Ching Wu[1-3], Peng-Yuan Chang[1,2], Tsung-Hsi Tu[1,2], Li-Yu Fay[1,2], Ching-Lan Wu[2,4], Huang-Chou Chang[5], Henrich Cheng[1-3]

OBJECTIVE: Several trials from the U.S. Food and Drug Administration have demonstrated the success of cervical disc arthroplasty (CDA) in patients with degenerative disc disease causing radiculopathy, myelopathy, or both. For patients who had increased intramedullary signal intensity (IISI) on magnetic resonance image (MRI), however, the effectiveness and safety of CDA was unclear. This study aimed to evaluate the outcomes of CDA for patients with IISI on preoperative MRI.

the JOA scores were generally worse. Follow-up MRI demonstrated significant regression of the length of IISI ($P = 0.009$). Both groups had preserved motion after CDA.

CONCLUSIONS: Both clinical and radiological outcomes improved (the average length of IISI in the cervical spinal cord became shorter) after CDA. Therefore, CDA is a safe and effective option for patients even when there is IISI on the preoperative T2-weighted MRI.

WORLD NEUROSURGERY 89: 489-496, MAY 2016

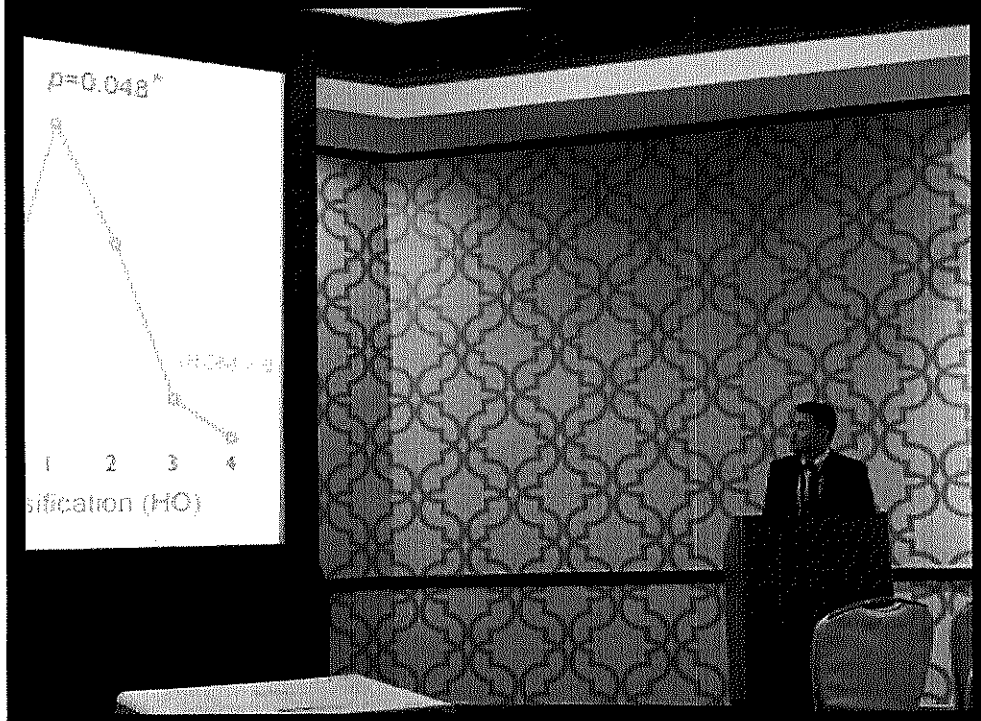
World Neurosurgery
May 2016

2017 AANS/CNS Spine Section Meeting

8:06–8:08 am
127 Can We Increase Segmental Mobility by Cervical Arthroplasty?
Hsuan-Kan Chang, Jau-Ching Wu, Chih-Chang Chang, Tsung-Hsi Tu

8:08–8:10 am
128 Fish-mouth Kyphosis of the Device After Cervical Disc Arthroplasty
Peng-Yuan Herb Chang, Chun-Hao Wang, Tsung-Hsi Tu, Jau-Ching Wu, Wen-Cheng Huang, Hsuan-Kan Chang, Li-Yu Fay, Ching-Lan Wu, Henrich Cheng

8:38–8:40 am
141 Reduction of Postoperative Narcotic Consumption in Awake TLIF: Enhanced Recovery After Surgery
Karthik Madhavan, Hsuan-Kan Chang, Timur Urakov, Lee Onn Chieng, Anand Veeravagu, Michael Y. Wang



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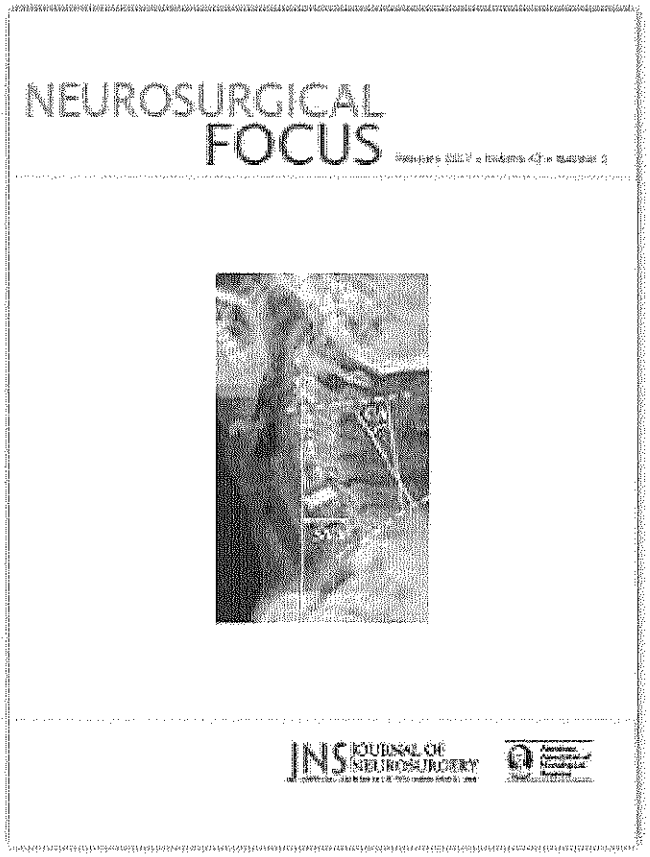
Neurosurgical Focus



FEATURED ARTICLE

Can segmental mobility be increased by cervical arthroplasty?

In addition to satisfactory clinical outcomes, successful preservation of segmental mobility after CDA has been demonstrated in several large-scale, prospective, randomized, controlled trials by the United States Food and Drug Administration.

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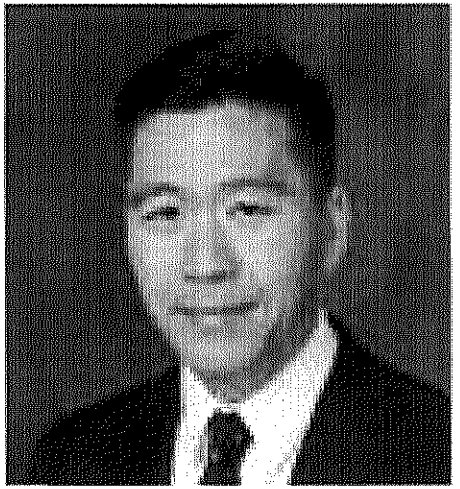
GENERAL SPINE 4 BREAKOUT

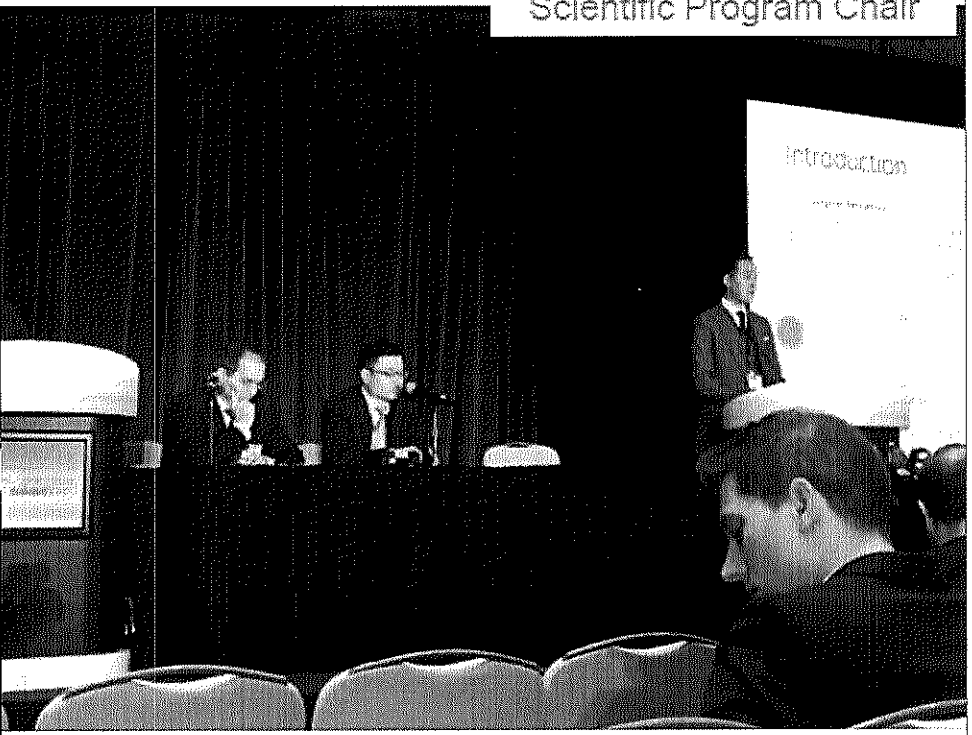
8:00-9:30 am

Marquis Ballroom
Salons 4/5



Daniel J. Hoh, MD
Scientific Program Chair

Moderators: *Hsuan-Kan Chang, Christoph Hofstetter*



NEUROSURGERY
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Article Navigation

Reduced Acute Care Costs With the ERAS® Minimally Invasive Transforaminal Lumbar Interbody Fusion Compared With Conventional Minimally Invasive Transforaminal Lumbar Interbody Fusion

Michael Y. Wang, MD, Hsuan Kan Chang, MD, Jay Grossman, MD

Neurosurgery, nyx400, https://doi.org/10.1093/neuros/nyx400
Published: 28 July 2017 **Article history**

NEUROSURGICAL FOCUS
Neurosurg

Can segmental mobility be increased by cervical arthroplasty?

*Hsuan-Kan Chang, MD,[1,2] Chih-Chang Chang, MD,[1,2] Tsung-Hsi Tu, MD,[1,2] Jau-Ching Wu, MD, PhD,[1,2] Wen-Cheng Huang, MD, PhD,[1,2] Li-Yu Fay, MD,[1–3] Peng-Yuan Chang, MD,[1,2] Ching-Lan Wu, MD,[2,4] and Henrich Cheng, MD, PhD[1–3]

ORIGINAL ARTICLE

CrossMark

Journal of Neurosurgery: Spine
May 2017 / Vol. 26 / No. 5 / Pages 577-585

Is cervical disc arthroplasty good for congenital cervical stenosis?

Peng-Yuan Chang, MD[1,2], Hsuan-Kan Chang, MD[1,2], Jau-Ching Wu, MD, PhD[1,2], Wen-Cheng ...Show al

Should Cervical Disc Arthroplasty Be Done on Patients with Increased Intramedullary Signal Intensity on Magnetic Resonance Imaging?

Hsuan-Kan Chang[1,2], Wen-Cheng Huang[1,2], Jau-Ching Wu[1-3], Peng-Yuan Chang[1,2], Tsung-Hsi Tu[1,2], Li-Yu Fay[1,2], Ching-Lan Wu[2-4], Huang-Chou Chang[5], Henrich Cheng[1-3]

WORLD NEUROSURGERY 89: 489-496, MAY 2016

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Article Navigation

Abnormal Cerebrospinal Fluid Flow: A New Model of Idiopathic Scoliosis

John Paul G. Kolcun, BS, Hsuan-Kan Chang, MD, Michael Y. Wang, MD

Neurosurgery, Volume 79, Issue 6, 1 December 2016, Pages N20–N21,
https://doi.org/10.1227/01.neu.0000508606.46318.77
Published: 01 December 2016

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Article Navigation

Neuroregeneration: North America's First Human Stem Cell Trial f Stroke

Hsuan-Kan Chang, MD, Anand Veeravagu, MD, Michael Y. Wang, MD

Neurosurgery, Volume 79, Issue 6, 1 December 2016, Pages N21–N22,
https://doi.org/10.1227/01.neu.0000508607.84436.6d
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WORLD NEUROSURGERY

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Wireless Intracranial Monitor: A Bioresorbable Silicon Sensor

John Paul G. Kolcun, Hsuan-Kan Chang, Michael Y. Wang
University of Miami, Miller School of Medicine, Miami, Florida, USA

WORLD NEUROSURGERY

Hybrid Corpectomy and Disc Arthroplasty for Cervical Spondylotic Myelopathy Caused by Ossification of Posterior Longitudinal Ligament and Disc Herniation

Huang-Chou Chang, Tsung-Hsi Tu, Hsuan-Kan Chang, Jau-Ching Wu, Li-Yu Fay, Peng-Yuan Chang, Ching-Lan Wu, Wen-Cheng Huang, Henrich Cheng

NEUROSURGERY
THE REGISTER OF THE NEUROSURGICAL MEME

Article Navigation

Food and Drug Administration Issues Warning of Neurodevelopmental Risks With General Anesthesia

John Paul G. Kolcun, BS, Ken Hsuan-kan Chang, MD, Michael Y. Wang, MD, FACS

Neurosurgery, Volume 81, Issue 1, 1 July 2017, Pages N10, https://doi.org/10.1093/neuros/nyx266
Published: 23 June 2017

NEUROSURGICAL FOCUS

Neurosurg Focus 42 (5):E1

Robotic paravertebral schwannoma resection at extreme locations of the thoracic cavity

Giacomo Pacchiarotti, MS,[1] Michael Y. Wang, MD,[2] John Paul G. Kolcun, BS,[2] Ken Hsuan-kan Chang, MD,[2] Motasem Al Maaieh, MD,[3] Victor S. Reis, MD,[4] and Dao M. Nguyen, MD[4] *corresponding

NEUROSURGICAL FOCUS

Initial academic experience and learning curv robotic spine instrumentation

Timur M. Urakov, MD, Ken Hsuan-kan Chang, MD, S. Shelby Burks, MD, and

Department of Neurological Surgery, University of Miami Miller School of Medicine, Miami, Florida

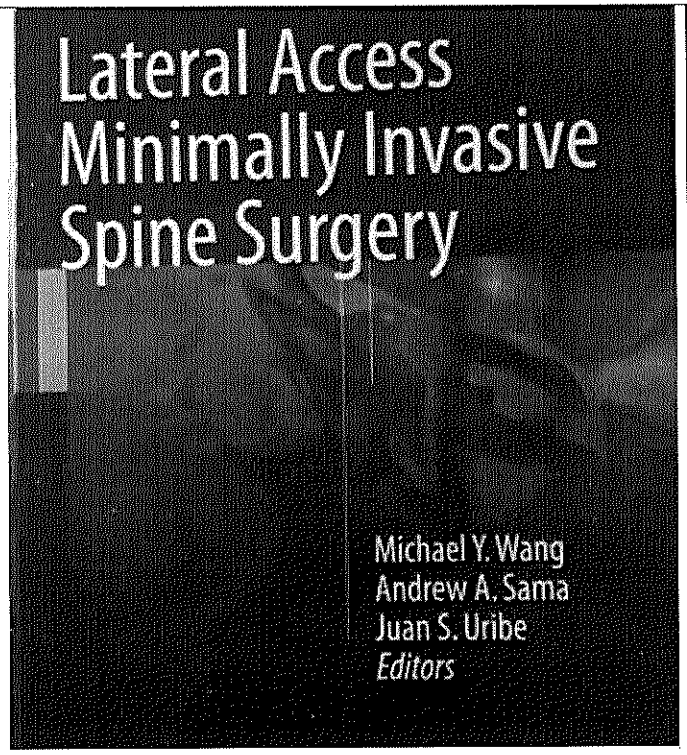
NEUROSURGERY
THE REGISTER OF THE NEUROSURGICAL MEME

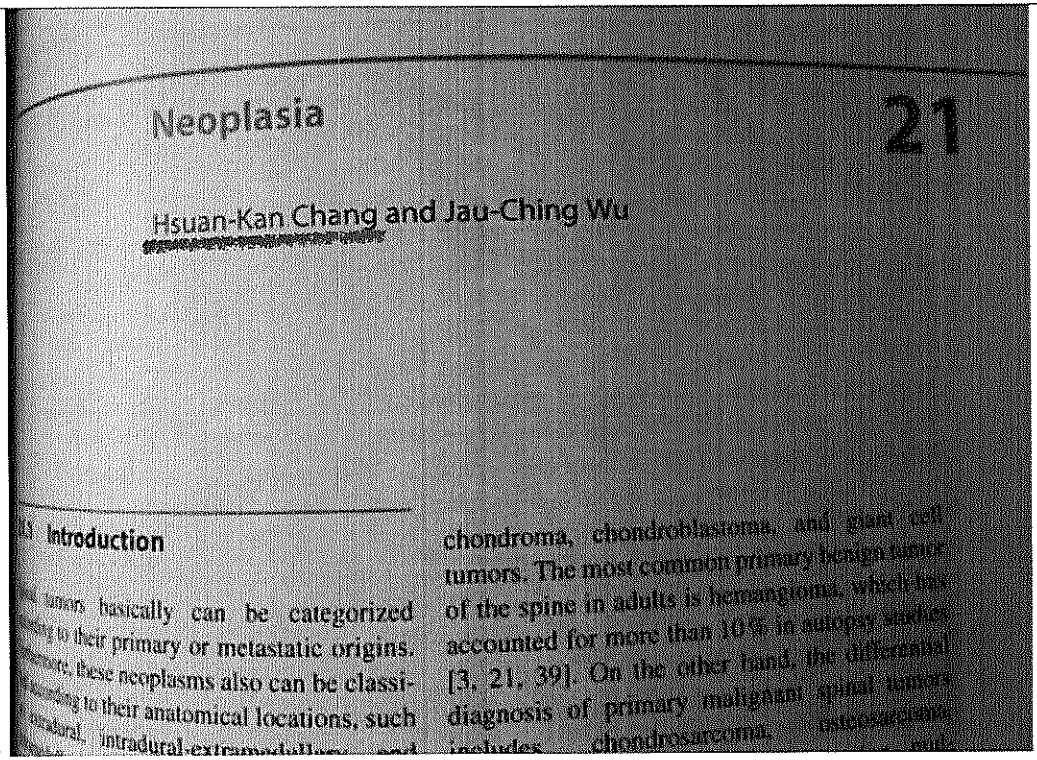
Article Navigation

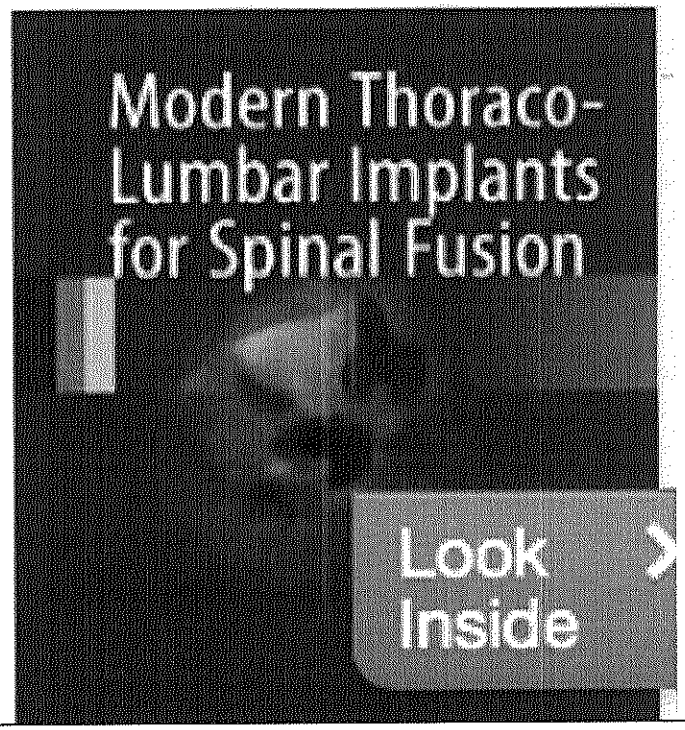
Stem Cell Transplantation Helps Alleviate Spinal Cord Injury Sequelae in Mice

John Paul G. Kolcun, BS, Hsuan-Kan Chang, MD, Michael Y. Wang, MD

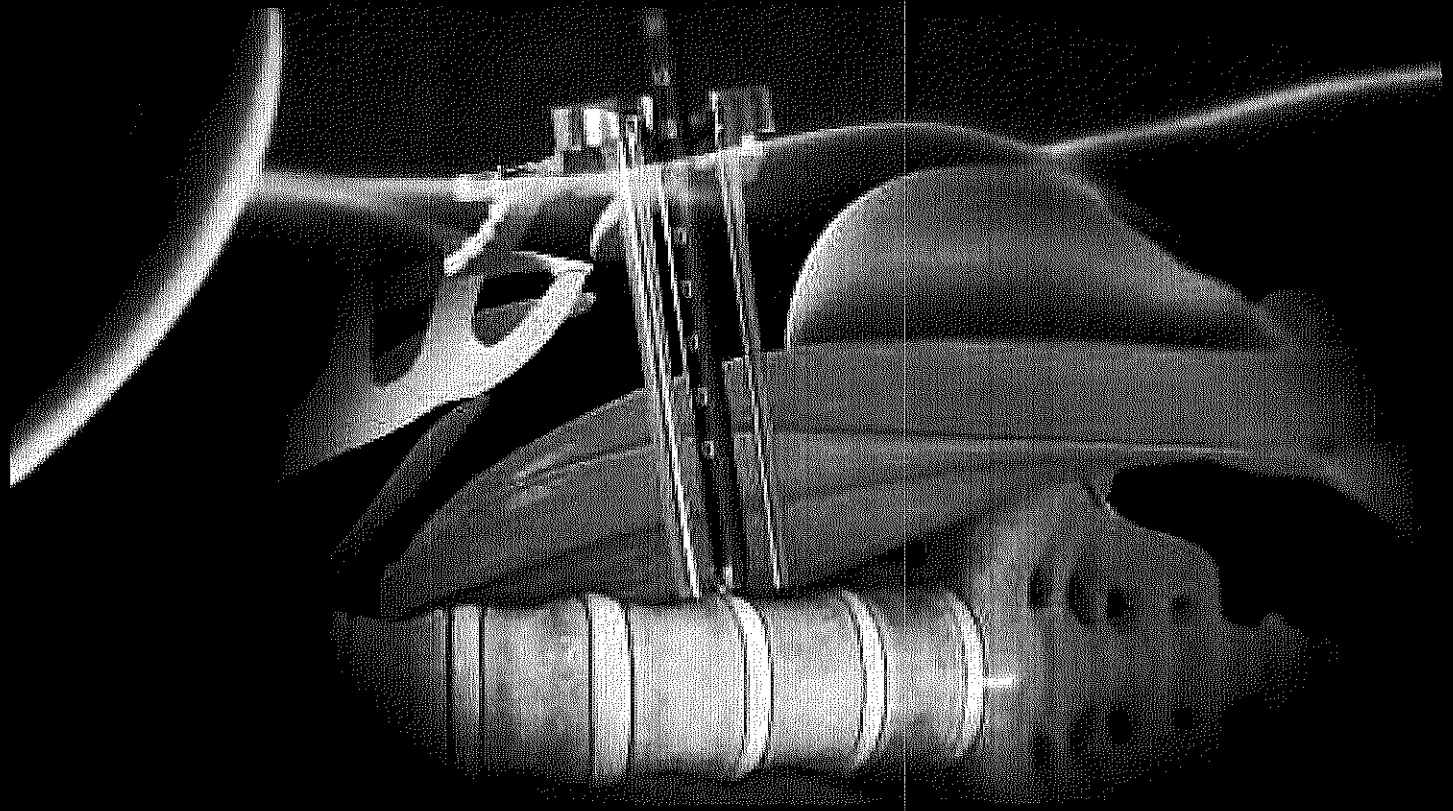
Neurosurgery, Volume 80, Issue 3, 1 March 2017, Pages N12–N14, https://doi.org/10.1093/neuros/nyx236
Published: 18 February 2017

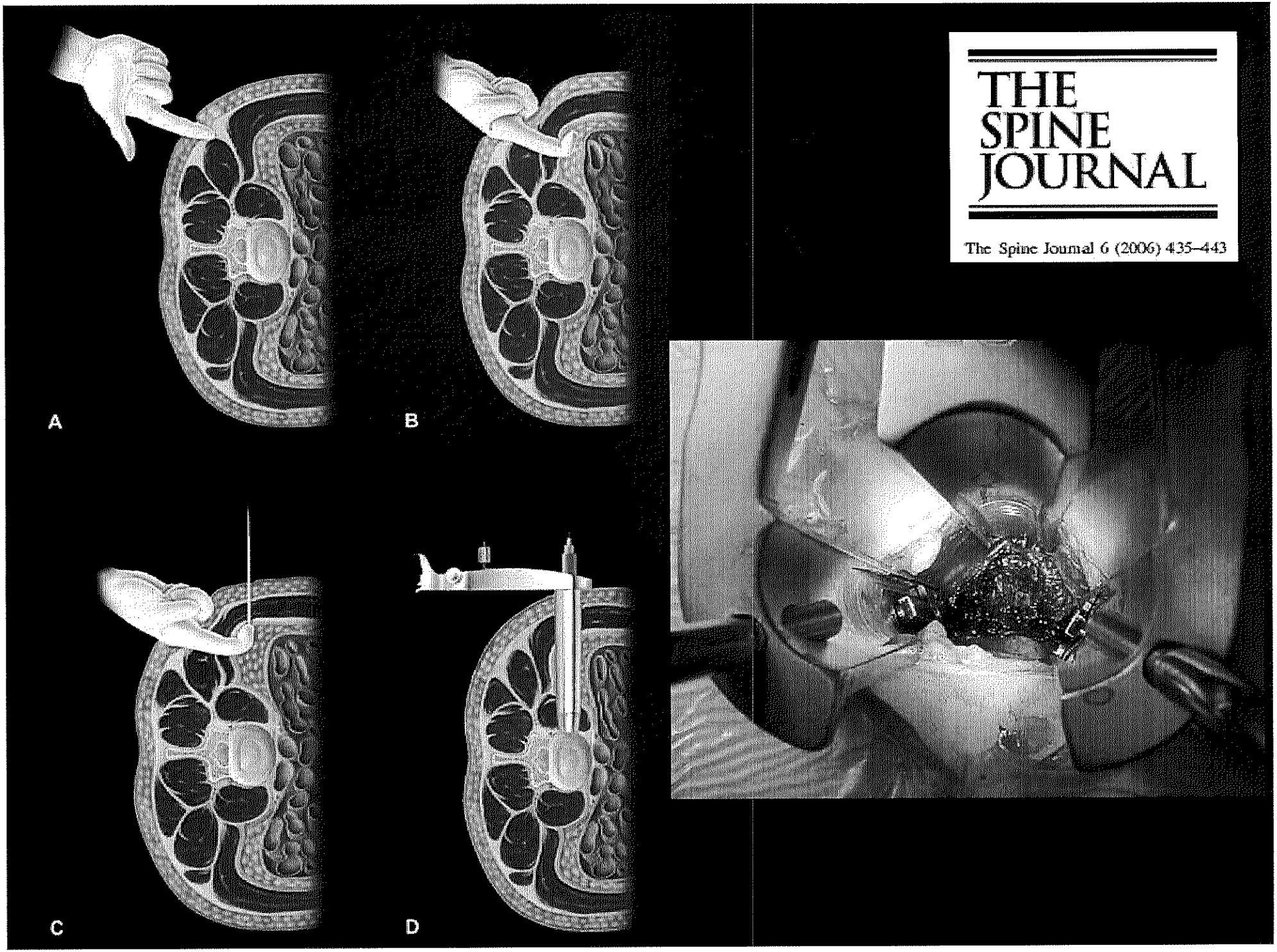






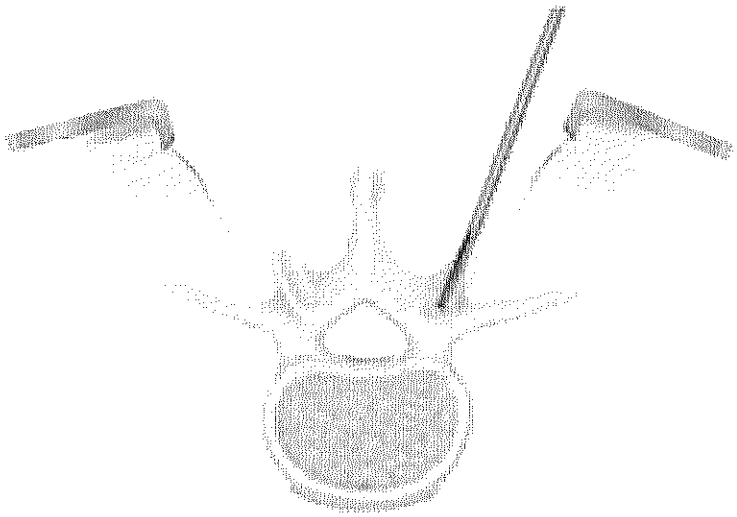
Anterio-lateral Approach
XLIF/DLIF/OLIF/ALIF



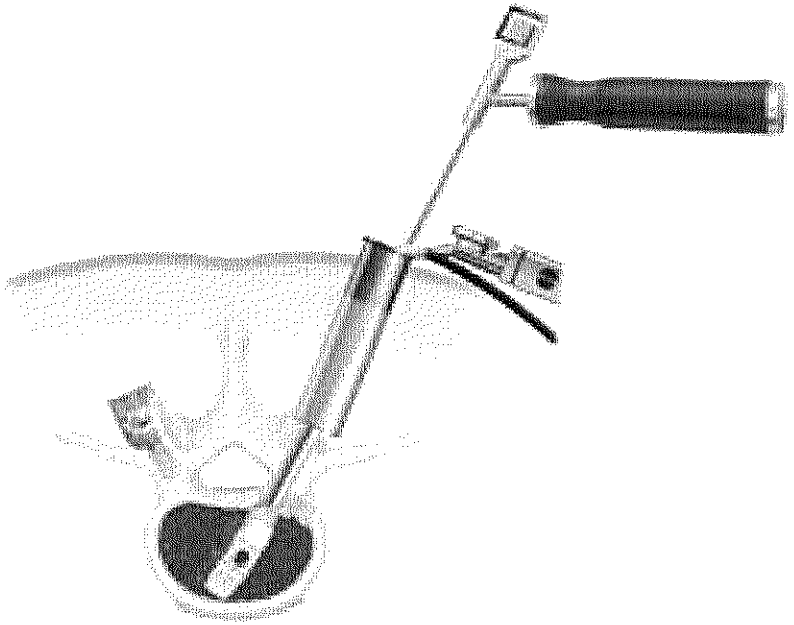


THE SPINE JOURNAL

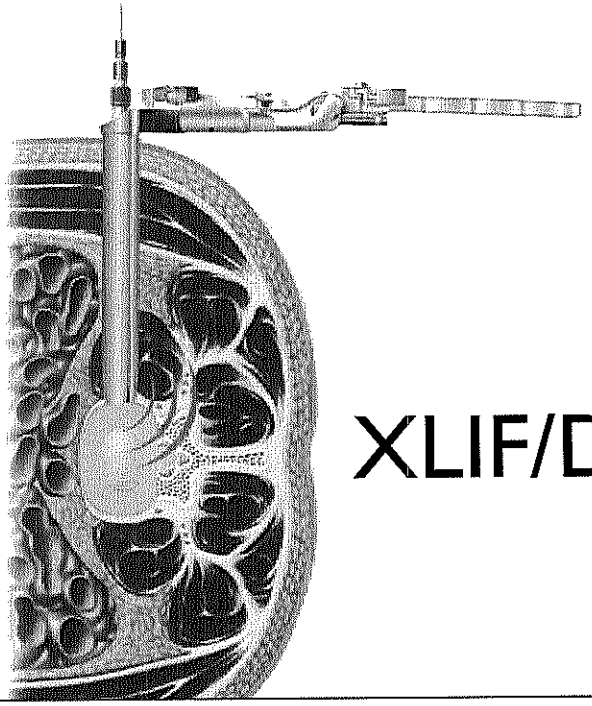
The Spine Journal 6 (2006) 435–443



"Open" TLIF

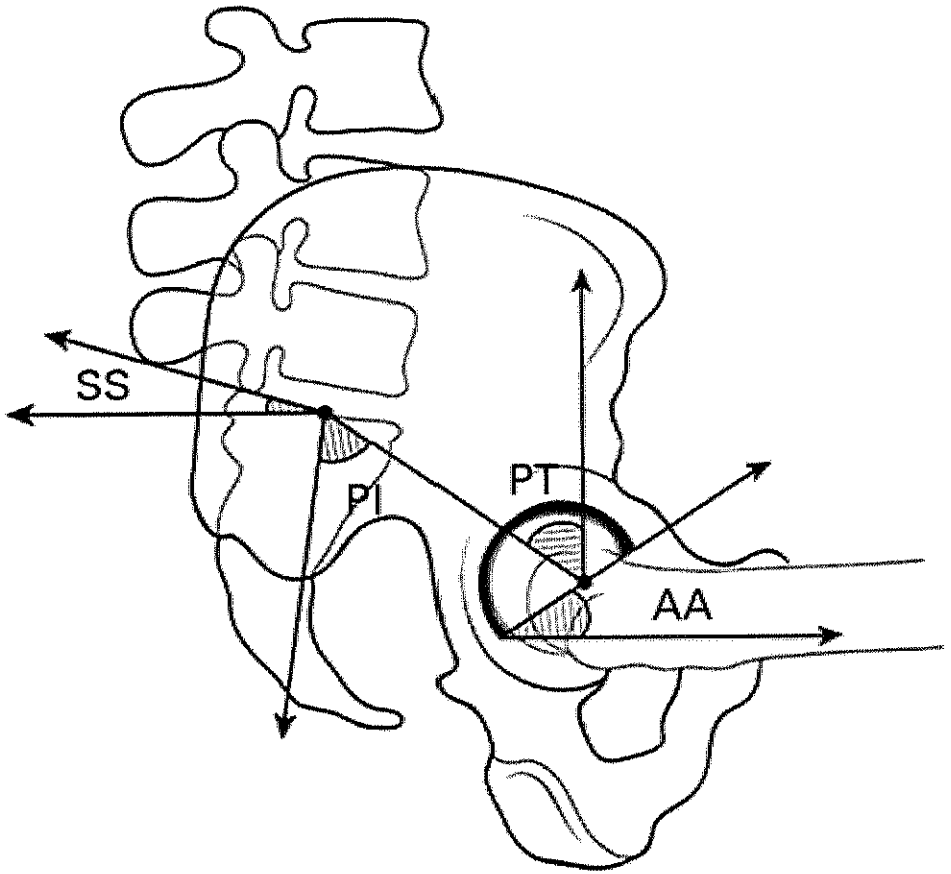


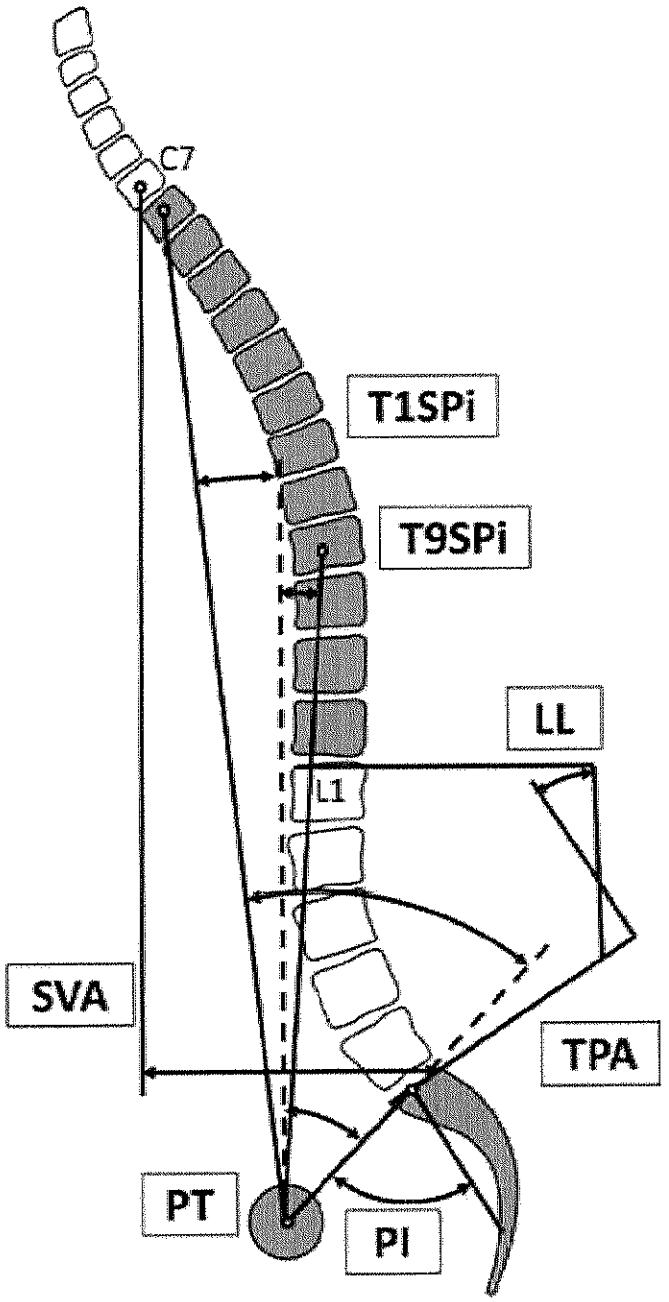
Minimally Invasive TLIF

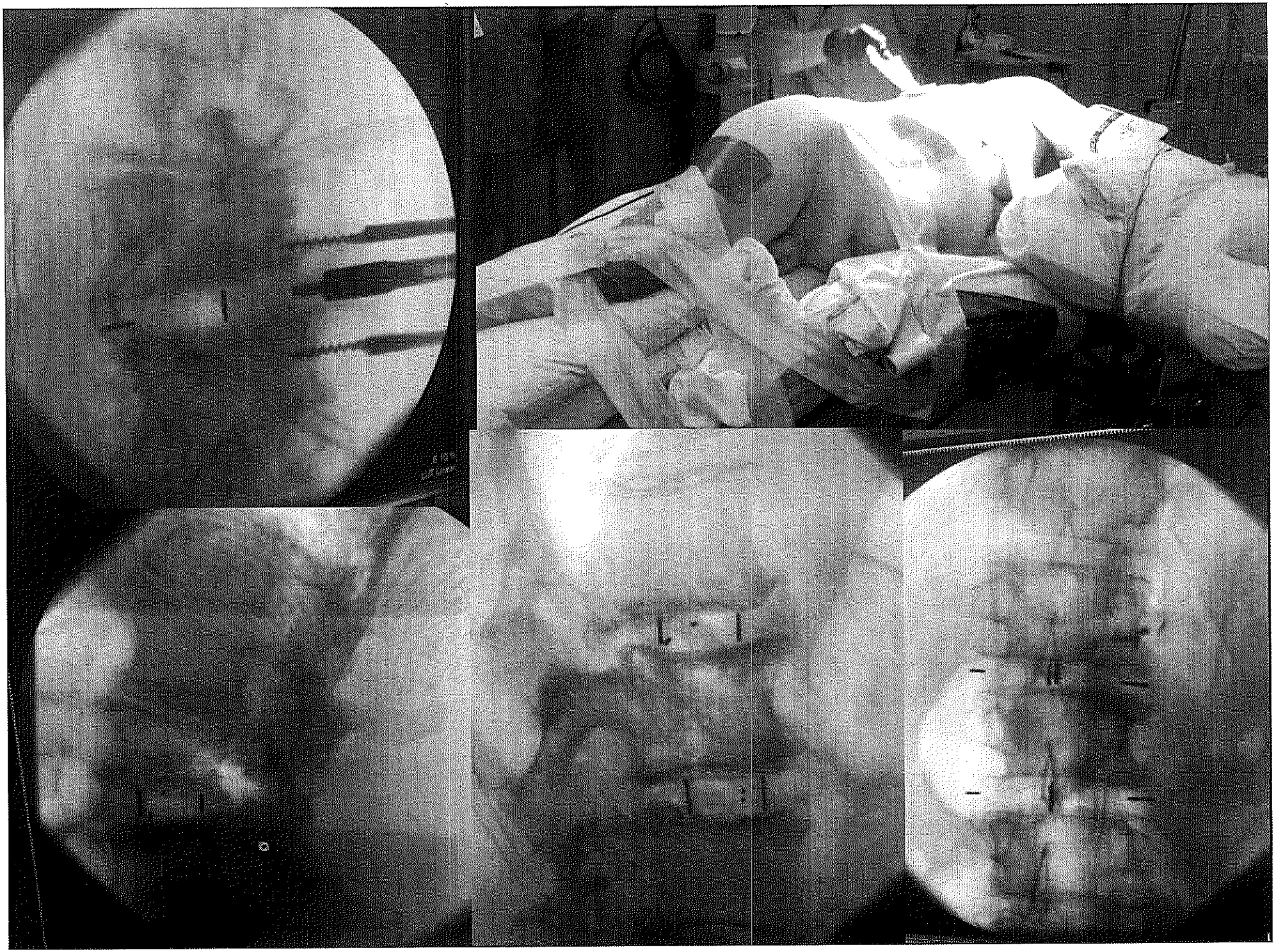


XLIF/DLIF/OLIF

Spinopelvic Parameters







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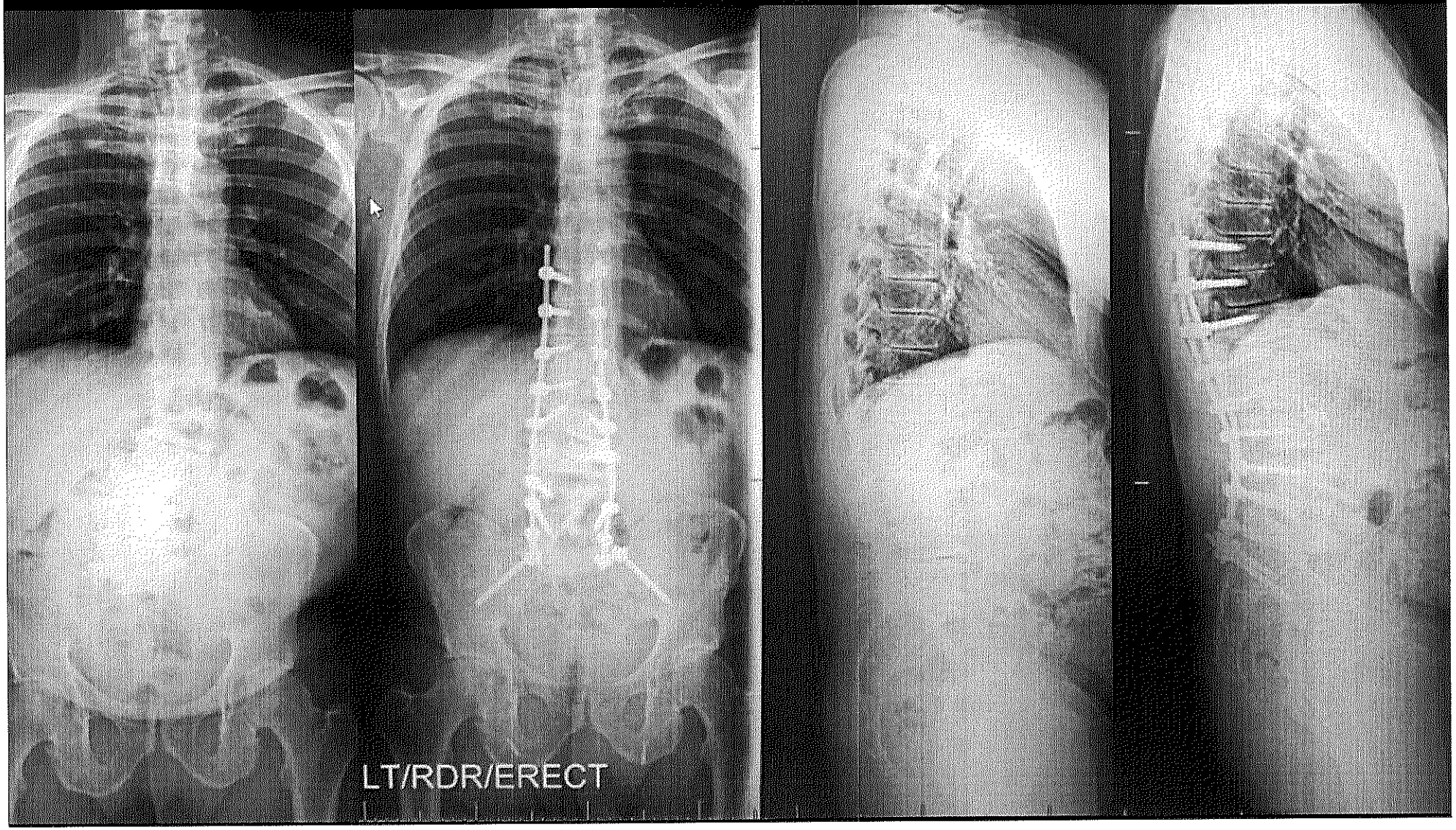
XLIF/DLIF/OLIF/ALIF
--> MIS Deformity



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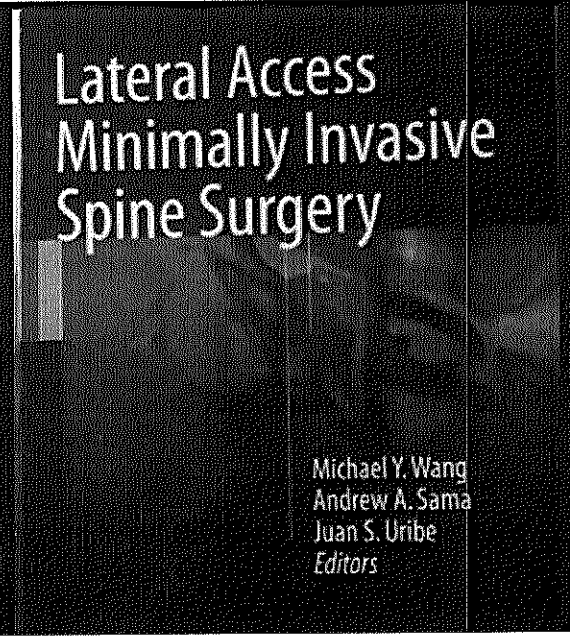
--> MIS Deformity

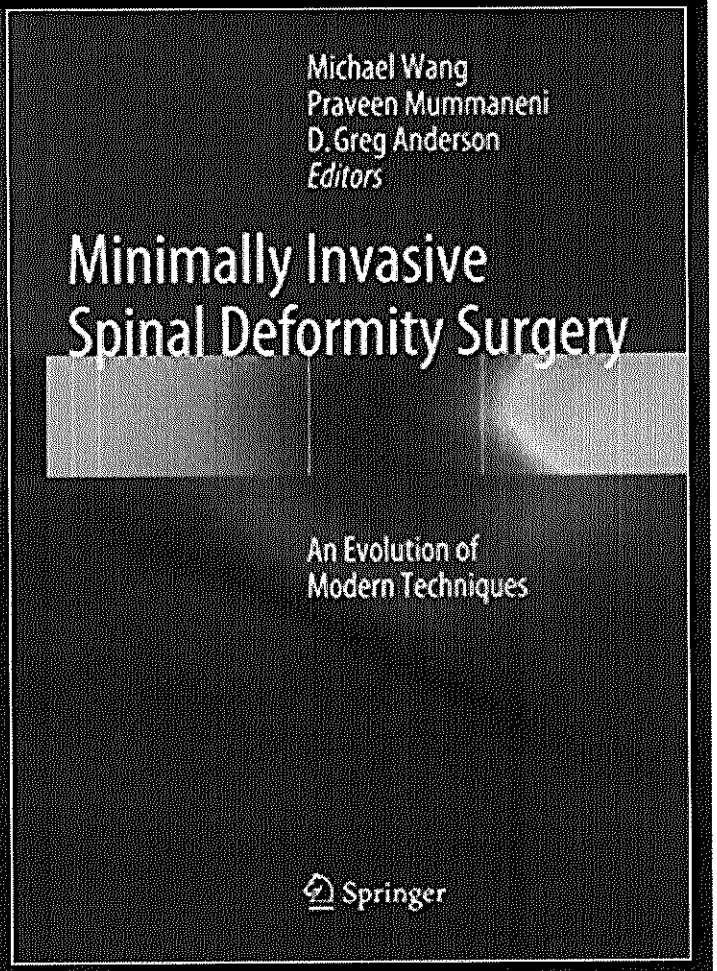
Neurosurg Focus 28 (3):E9, 2010

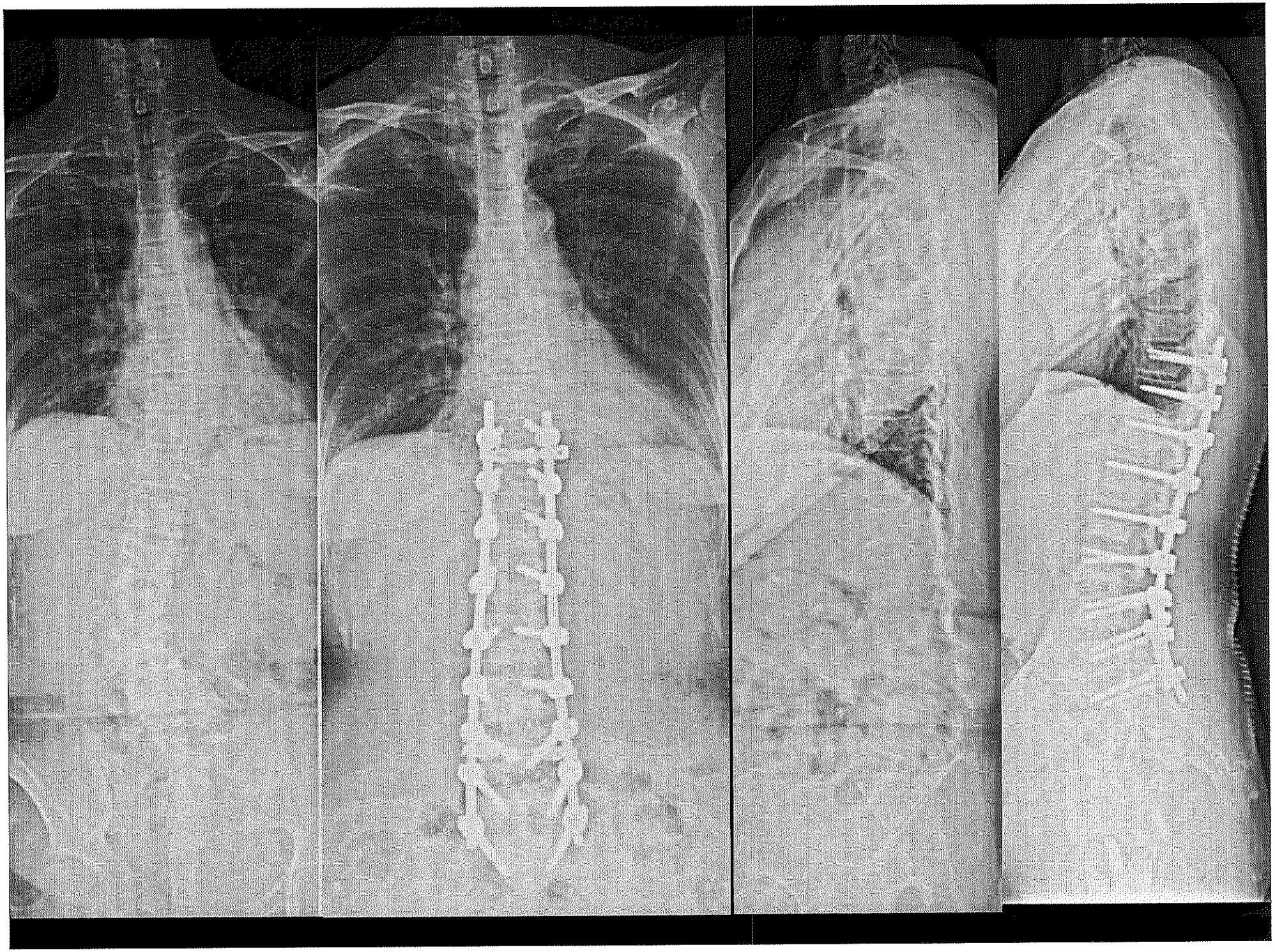
Minimally invasive surgery for thoracolumbar spinal deformity: initial clinical experience with clinical and radiographic outcomes

Michael Y. Wang, M.D.,[1] and Praveen V. Mummaneni, M.D.[2]

[1]*Department of Neurological Surgery, University of Miami Miller School of Medicine, Lois Pope LIFE Center, Miami, Florida; and* [2]*Department of Neurological Surgery, University of California, San Francisco, California*







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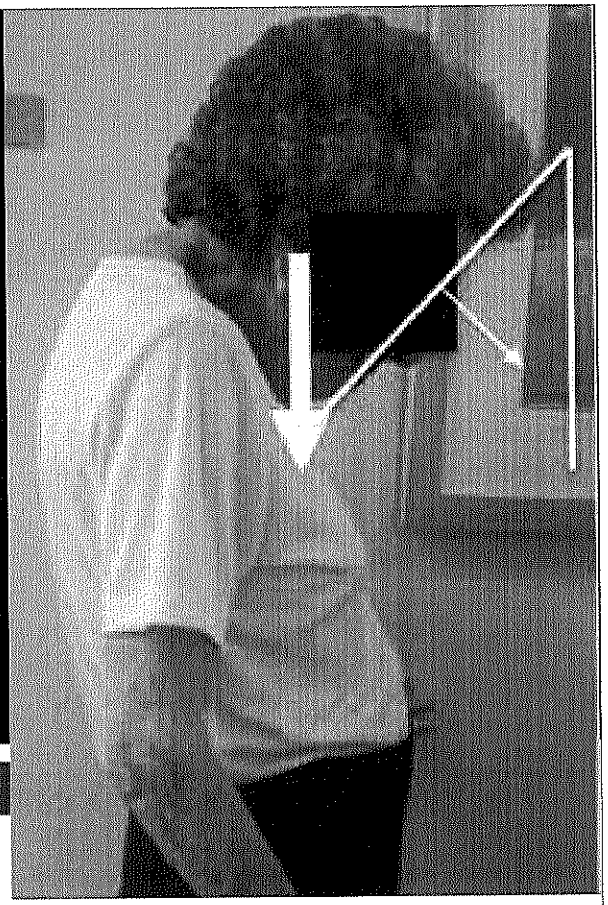
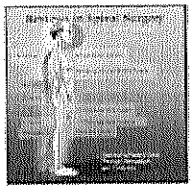
Cervical Spine Deformity





Cervical Spine Deformity—Part 1: Biomechanics, Radiographic Parameters, and Classification

Lee A. Tan, MD*

K. Daniel Riew, MD*

Vincent C. Traynelis, MD†

*Department of Orthopedic Surgery, Columbia University Medical Center/ New York Presbyterian Hospital, New York, New York; †Department of Neurosurgery, Rush University Medical Center, Chicago, Illinois

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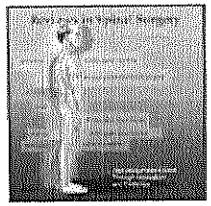
1725 W. Harrison St. Suite 855,

Cervical spine deformities can have a significant negative impact on the quality of life by causing pain, myelopathy, radiculopathy, sensorimotor deficits, as well as inability to maintain horizontal gaze in severe cases. Many different surgical options exist for operative management of cervical spine deformities. However, selecting the correct approach that ensures the optima
aim to provide an
including the biome
surgical technique
pertinent literature.

KEY WORDS: Cervical
subtraction osteotomy,

Neurosurgery 81:197–203, 201



Cervical Spine Deformity—Part 2: Management Algorithm and Anterior Techniques

Lee A. Tan, MD*

K. Daniel Riew, MD*

Vincent C. Traynelis, MD†

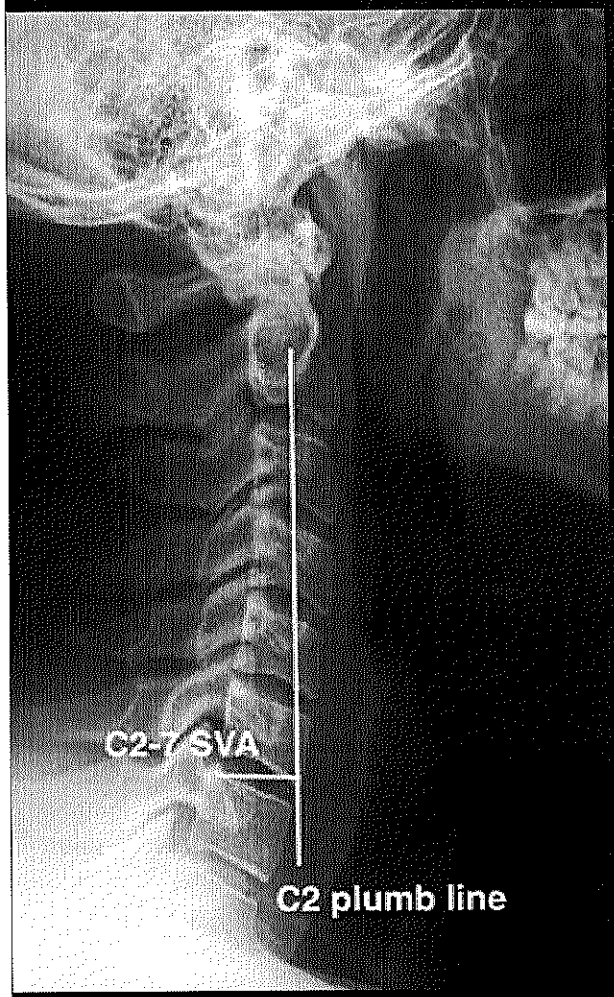
*Department of Orthopedic Surgery, Columbia University Medical Center/New York Presbyterian Hospital, New York, New York; †Department of Neurosurgery, Rush University Medical Center, Chicago, Illinois

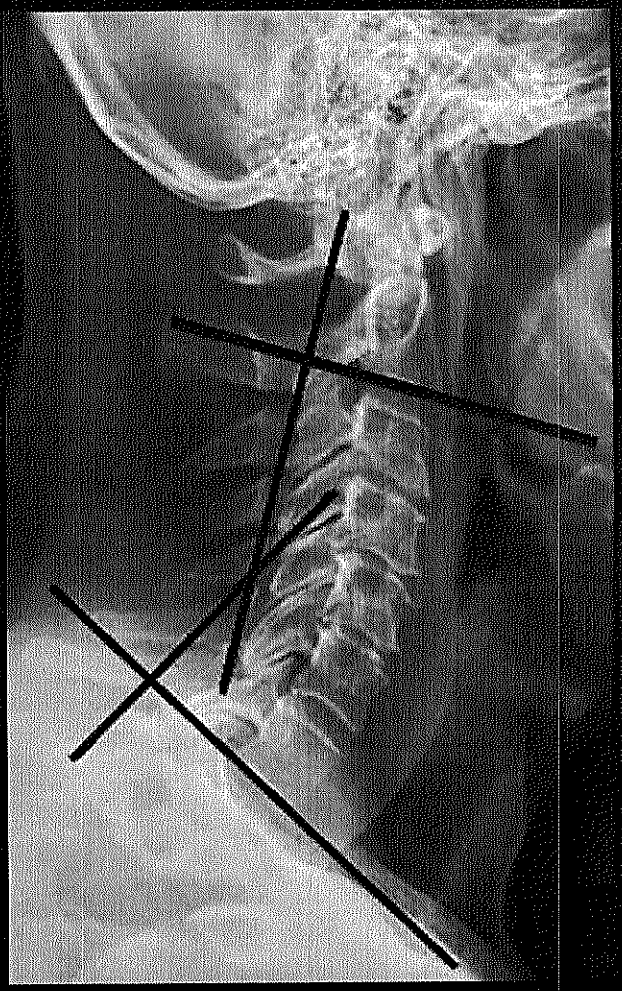
Correspondence:
Vincent C. Traynelis, MD,

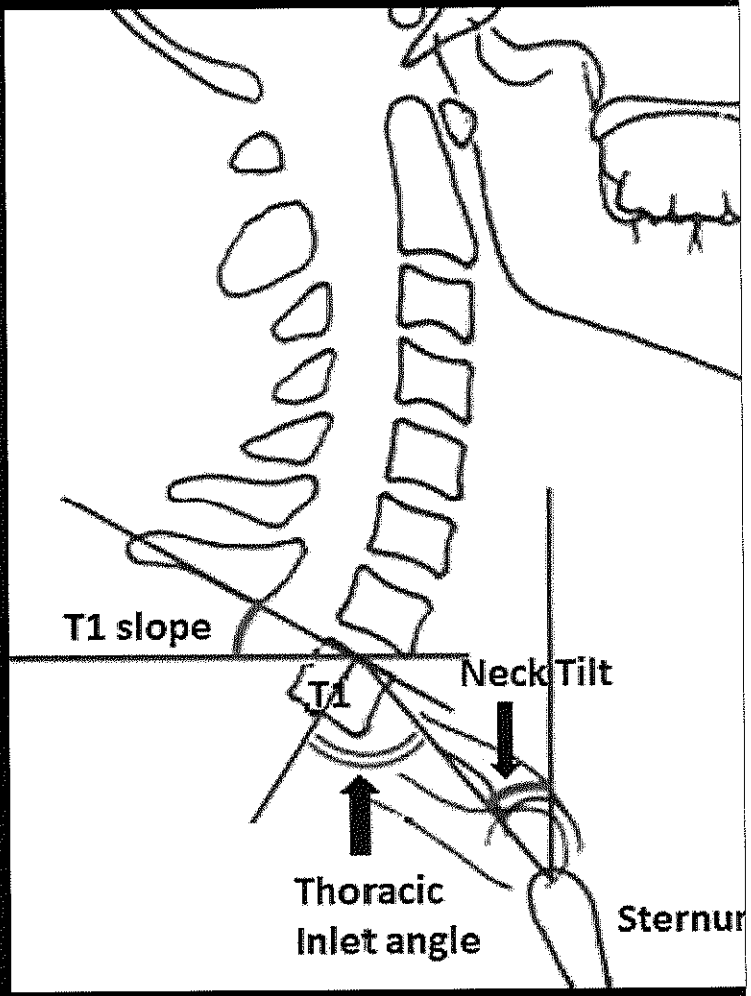
A sound operative plan based on solid understanding of the pathology and biomechanics is the most important part of cervical deformity correction. Many different surgical options exist for operative management of cervical spine deformities. However, selecting the correct approach that ensures the optimal clinical outcome can be challenging and often controversial. In Part 2 of this three-part review series, we discuss the pre-operative planning, management algorithm, and anterior surgical techniques for cervical deformity correction.

KEY WORDS: Cervical spine deformity, Cervical kyphosis, Osteotomies, Smith-Petersen osteotomy, Pedicle subtraction osteotomy, Anterior osteotomy, Total subaxial reconstruction, Cervical lordosis, SVA, T1 slope

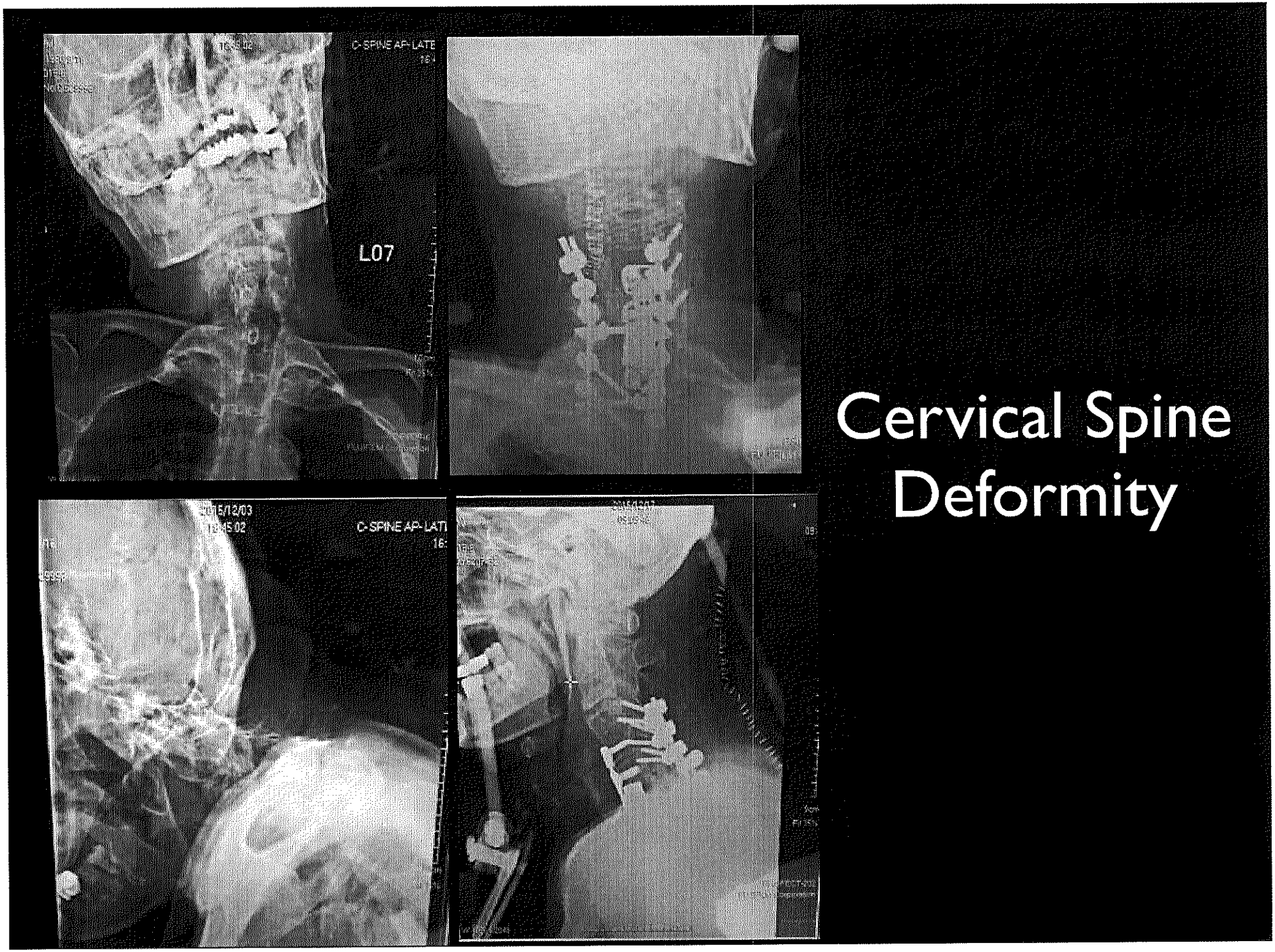
Neurosurgery 81:561–567, 2017 DOI:10.1093/neuros/nyx388 www.neurosurgery-online.com


C2-7 SVA
C2 plumb line



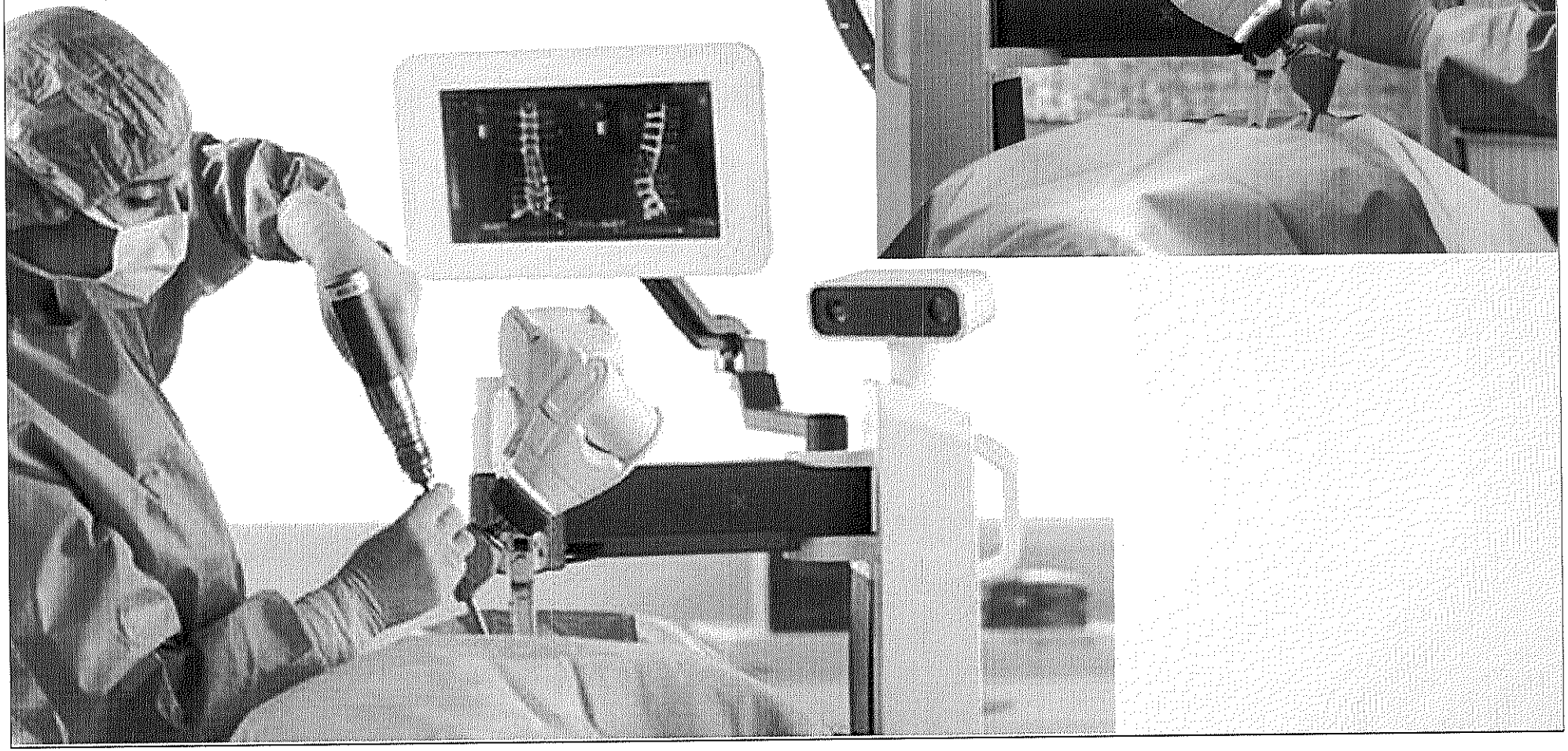

T1 slope
T1
Neck Tilt
Thoracic
Inlet angle
Sternur

Cervical Deformity



Cervical Spine Deformity

Robot-assisted Spinal Surgery



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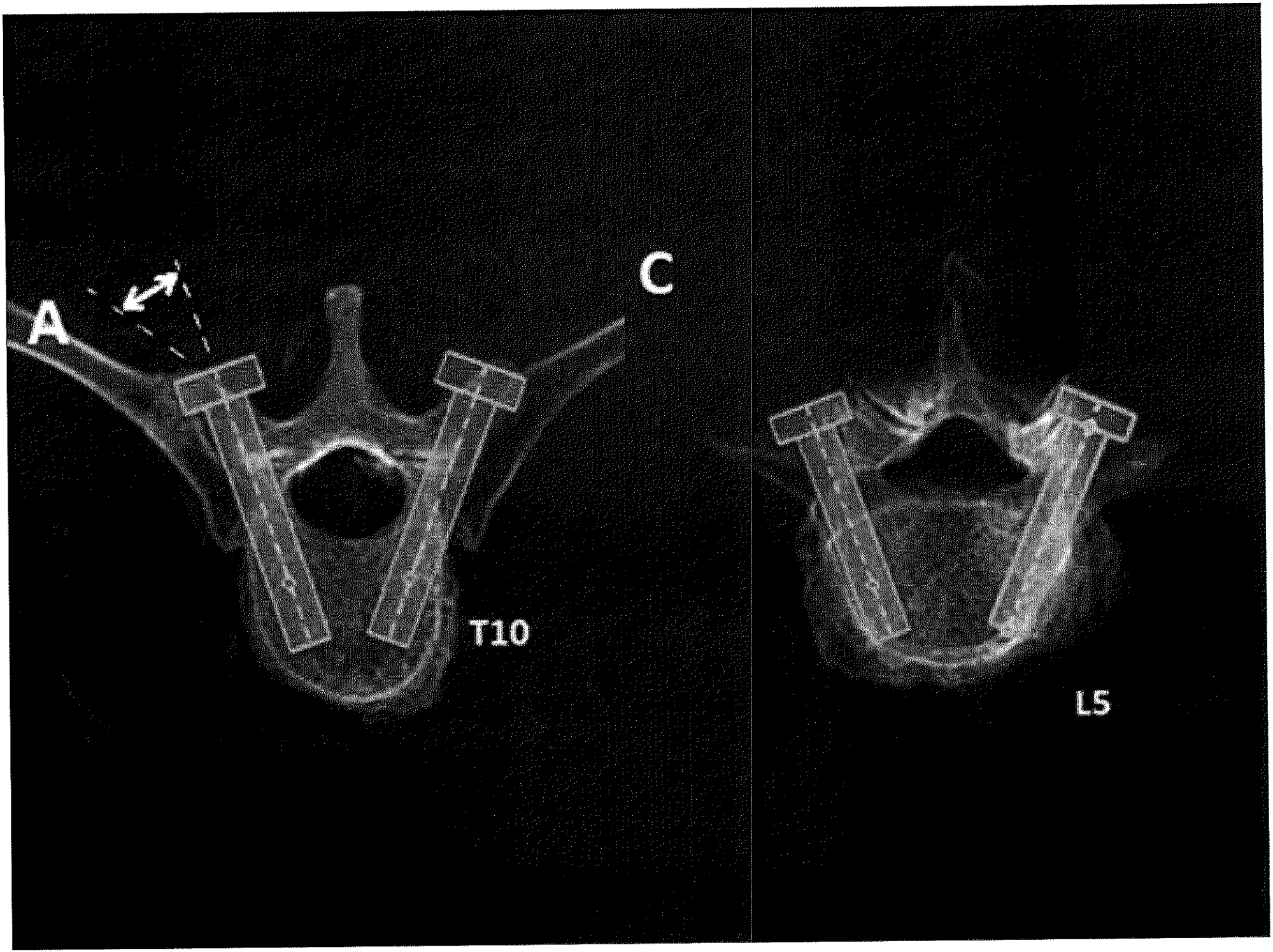

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NEUROSURGICAL FOCUS

Neurosurg Focus 42 (5):E4, 2017

Initial academic experience and learning curve with robotic spine instrumentation

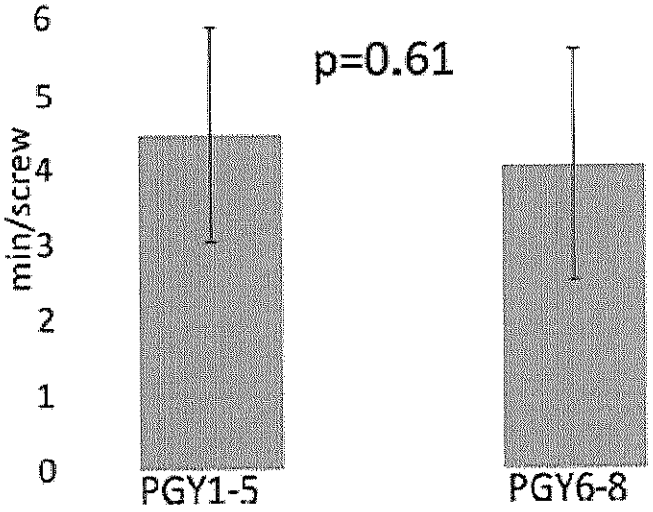
Timur M. Urakov, MD, Ken Hsuan-kan Chang, MD, S. Shelby Burks, MD, and Michael Y. Wang, MD

Department of Neurological Surgery, University of Miami Miller School of Medicine, Miami, Florida

- ≅ 4 min per screw
- Very low radiation
- high accuracy
- 0% revision

Robotic paravertebral schwannoma resection at extreme locations of the thoracic cavity

Giacomo Pacchiarotti, MS,[1] Michael Y. Wang, MD,[2] John Paul G. Kolcun, BS,[2] Ken Hsuan-kan Chang, MD,[2] Motasem Al Maaieh, MD,[3] Victor S. Reis, MD,[4] and Dao M. Nguyen, MD[4] * corresponding



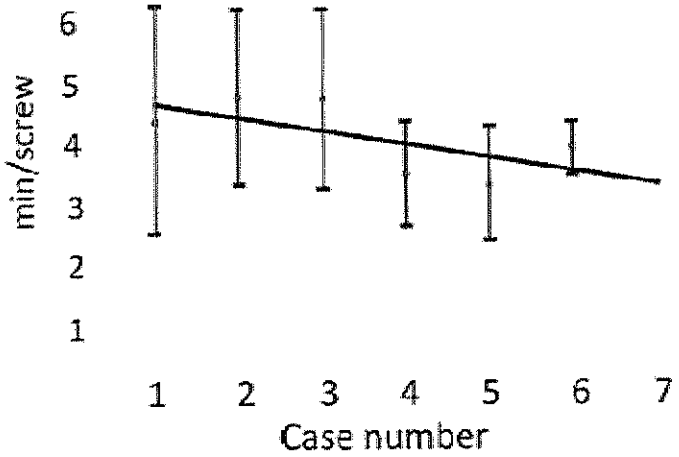


FIG. 1. Pedicle screw insertion speed based on years in training.

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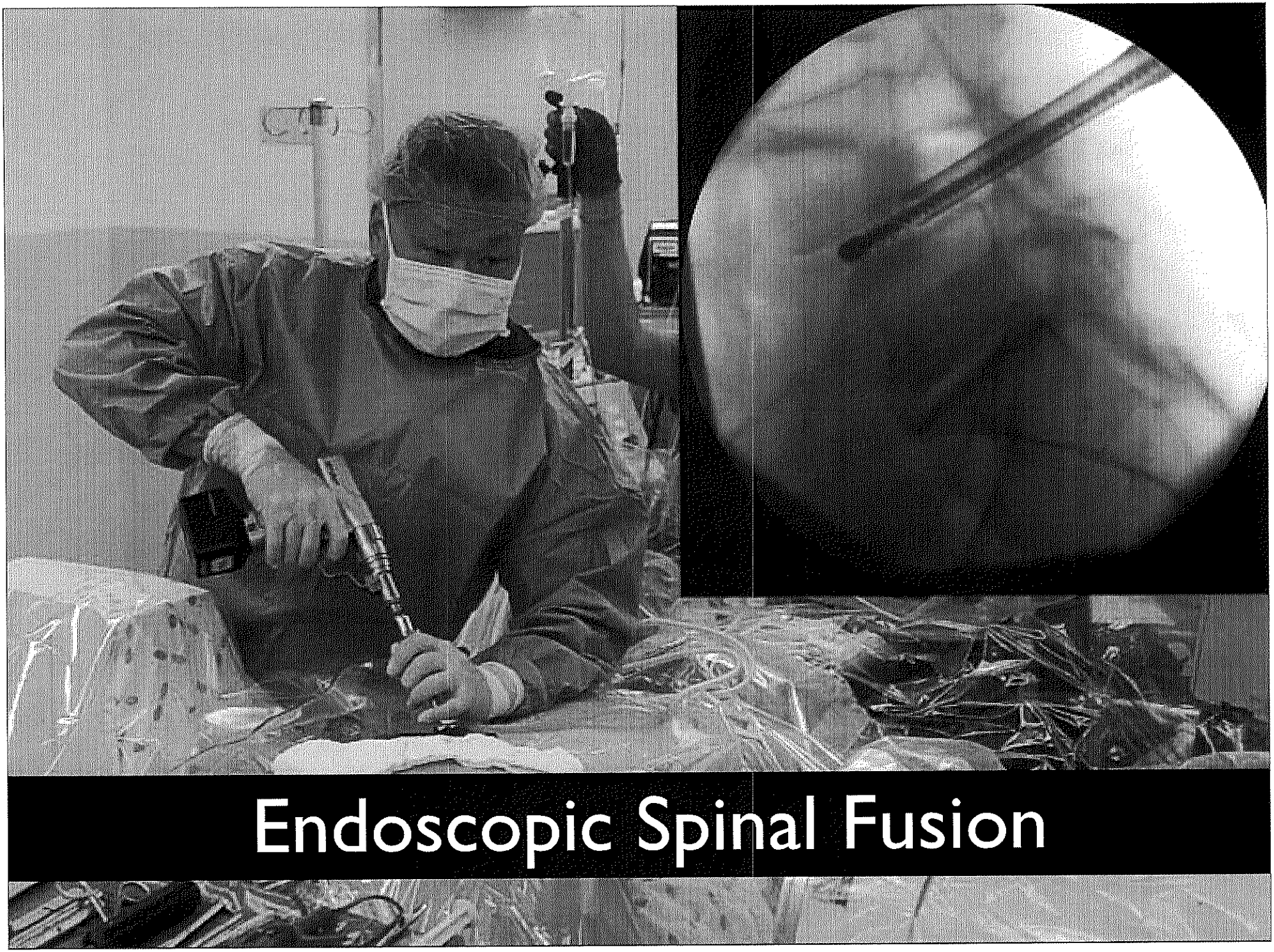
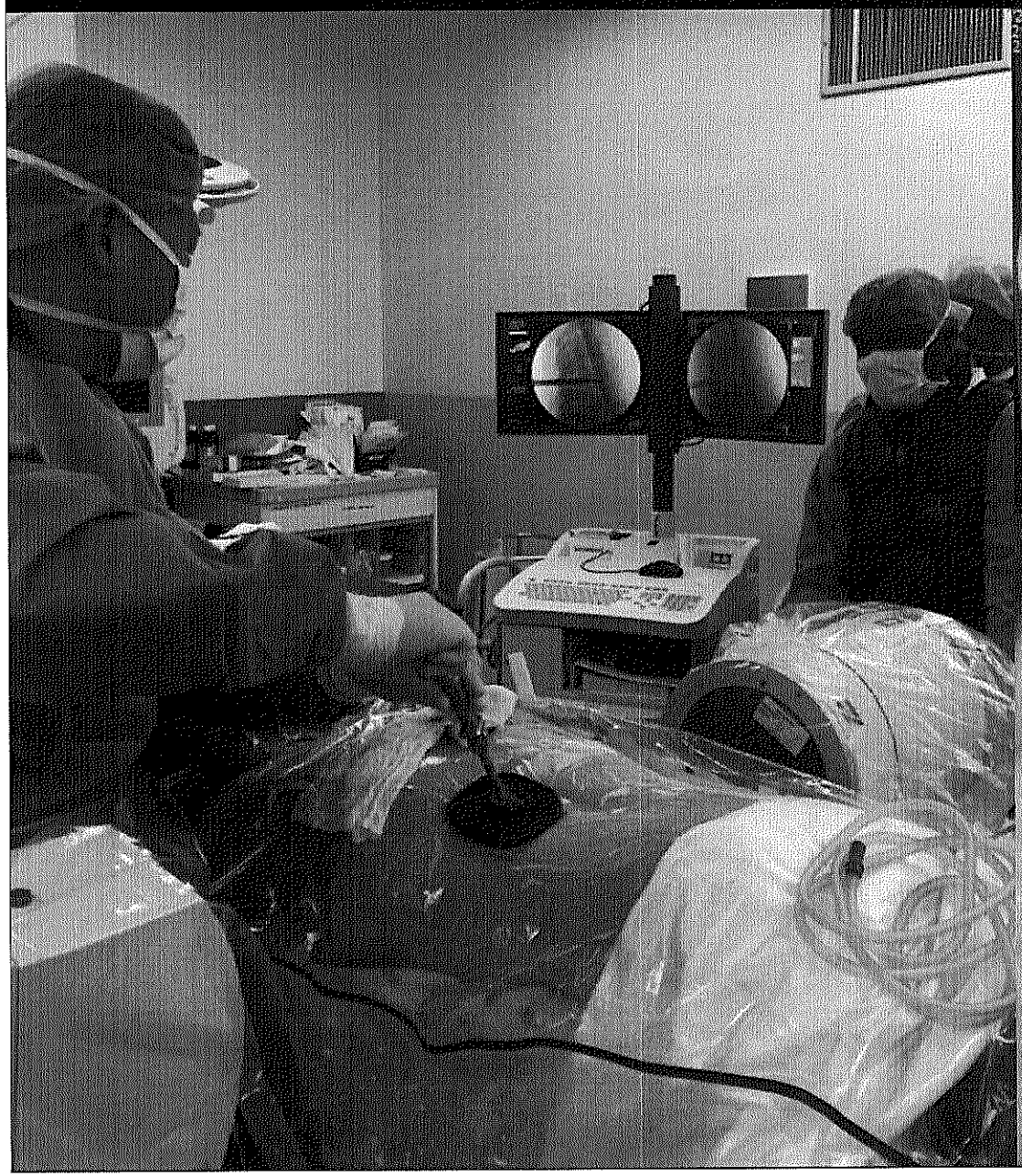
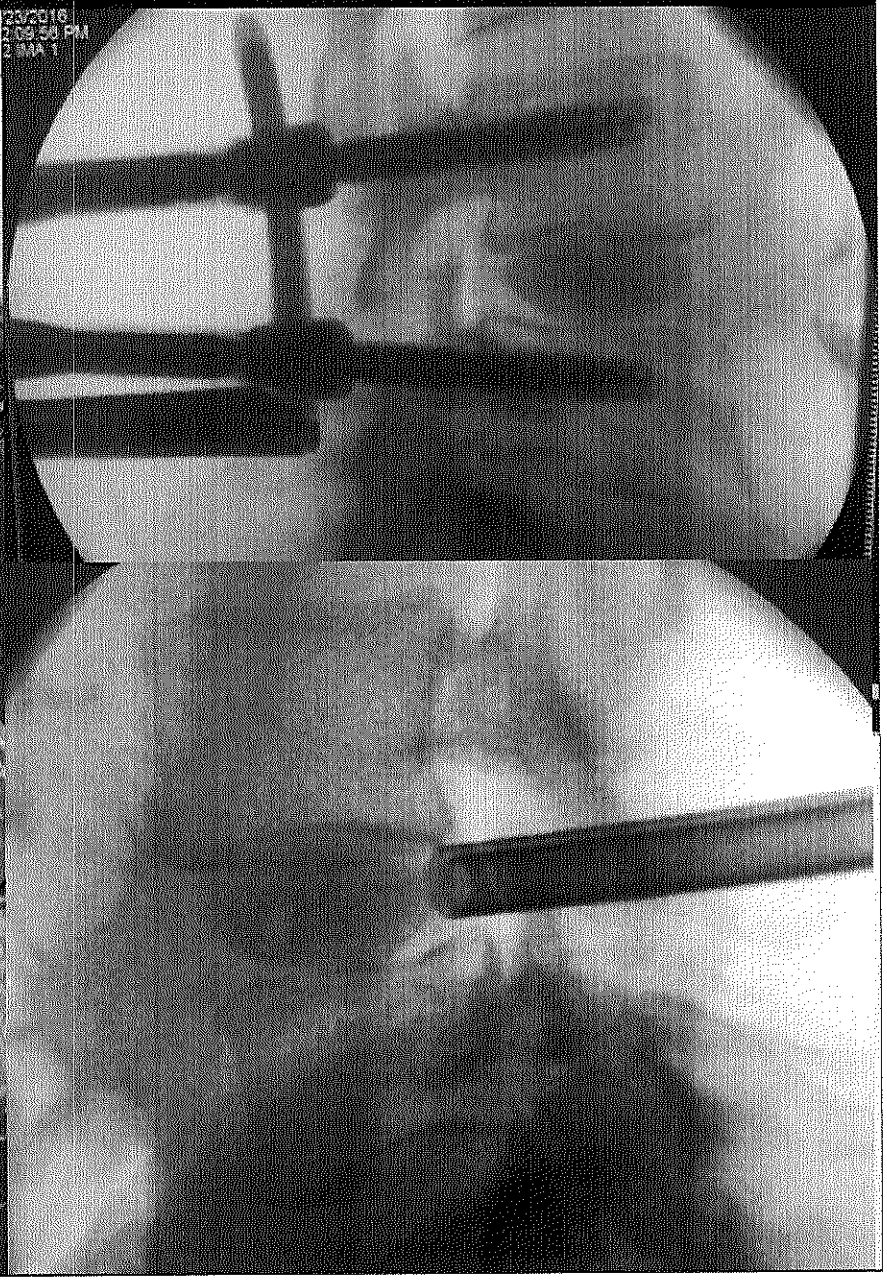


Endoscopic Spinal Fusion

Endoscopic Spinal Fusion





NEUROSURGERY
THE REGISTER OF THE NEUROSURGICAL MEME

Article Navigation

Reduced Acute Care Costs With the ERAS® Minimally Invasive Transforaminal Lumbar Interbody Fusion Compared With Conventional Minimally Invasive Transforaminal Lumbar Interbody Fusion

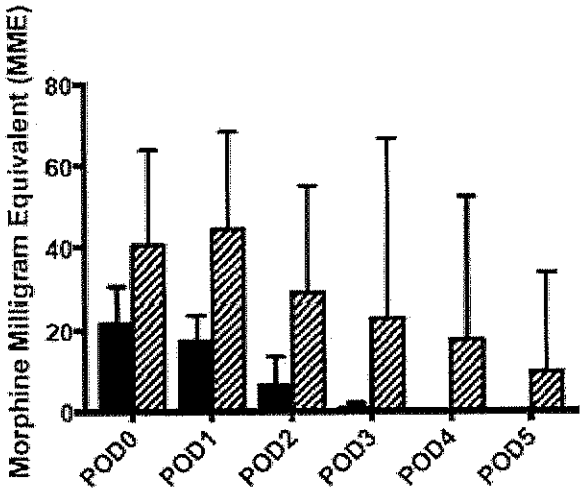
Michael Y. Wang, MD, Hsuan Kan Chang, MD, Jay Grossman, MD

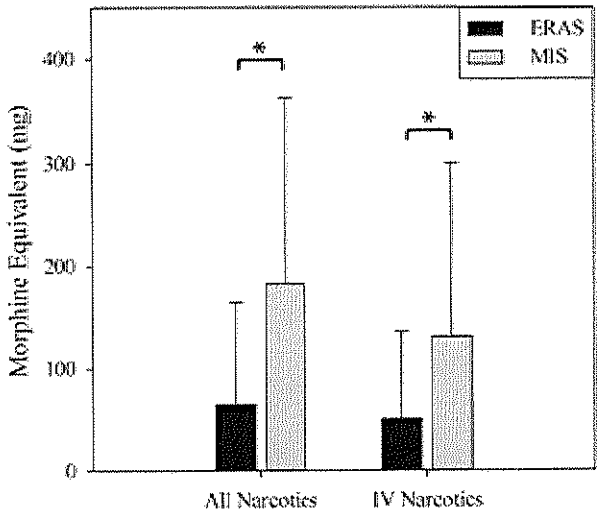
Neurosurgery, nyx400, https://doi.org/10.1093/neuros/nyx400
Published: 28 July 2017 **Article history** ▾

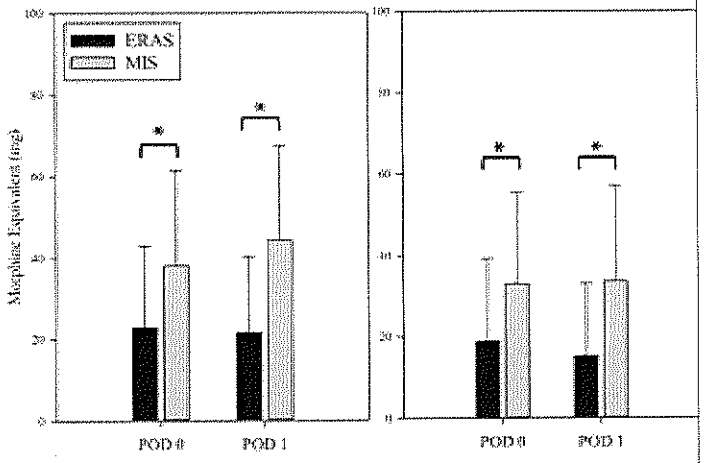
Reduced In-patient Narcotic Consumption and Hospital Stay with ERAS® Transforaminal Lumbar Interbody Fusion (TLIF): Comparison to Standard Minimally-Invasive TLIF

Karthik Madhavan, MD[1], Anand Veeravagu, MD[2], Timur M. Urakov, MD[1], Hsuan-Kan Chang, MD[1,3]*, and Michael Y. Wang, MD[1]

*corresponding





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