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第二屆脊柱側彎關懷：治療，手術安全與研究創新

Scoliosis 2025: Treatment, Safety, Innovation

時　　間：114 年 6 月 29 日(星期日) 08:30~13:30
地　　點：臺北榮民總醫院 致德樓十會議室

08:30-08:40	***Opening Remarks***	曾令民 副院長 Ling-Ming Tseng 吳文田理事長 Wen-Tien Wu

Working Together for Straighter Spines: Surgeon and Patient Perspectives on Scoliosis Correction

座長：曾效祖 醫師 (Tzeng Shiau-Tzu)

08:45-09:00	成人脊柱側彎階段性矯正手術的設計 Design the Staged Correction in Adult Deformity Surgery	羅元舜醫師 Yuan-Shun Lo
09:05-09:20	青少年特發性脊柱側彎治療的進展：美國科羅拉多兒童醫院的經驗 Advances in Adolescent Idiopathic Scoliosis Management	沈柏志醫師 Po-Chih Shen
09:25-09:40	早發性脊椎側彎手術治療經驗 My Learning Journey in Early Onset Scoliosis Surgery	吳冠彣醫師 Kuan-Wen Wu
09:40-10:00	綜合討論 Panel discussion	
10:00-10:30	***Coffee Break***	

Scoliosis Research: From Lab to Life

座長：劉承揚 教授 (Cheng-Yang Liu)

10:30-10:50	結構光技術加上深度學習對於側彎角度量測的運用 Application of Structured Light Combined with Deep Learning for Predicting Cobb Angles	蘇珮瑜 Pei-Yu Su
10:55-11:15	邁向可泛化的 Cobb 角測量：深度學習模型於跨資料集的驗證與評估 Towards Generalizable Cobb Angle Measurement: Evaluating a Deep Learning Model Across Multiple Datasets	呂芷儀 Chih-Yi Lu
11:15-11:30	綜合討論 Panel discussion	

The Key to Safe Scoliosis Correction: Unlocking the Secrets of Neuromonitoring

座長：楊翠芬 醫師 (Tsui-Fen Yang)

11:35-12:00	術中監測在脊椎側彎手術中的實務應用 Intraoperative Neurophysiological Monitoring (IONM) in Scoliosis Correction Surgery：A Clinical Perspective	邱然偉醫師 Jan-Wei Chiu
12:00-13:30 (lunch box)	神經監測技術介紹與實作 Neuromonitoring Technique and Practice	葉士維/王玉環 Shih-Wei Yeh

Design the staged correction in adult deformity surgery

成人脊柱側彎階段性矯正手術的設計

Yuan-Shun Lo

羅元舜

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Two-stage surgeries are increasingly used to minimize complications in adult spinal deformity (ASD) correction, yet the specific contributions of lateral lumbar interbody fusion (LLIF) and posterior column osteotomy/posterior spinal fusion (PCO/PSF) remain underexplored. This study evaluates their roles in deformity correction and establishes predictive thresholds for optimizing surgical planning. A total of 151 ASD patients (mean age 69.5 years) underwent staged LLIF and PCO/PSF surgeries one week apart. Radiographic parameters were analyzed preoperatively, post-LLIF, post-PCO/PSF, and at two-year follow-up. Correction rates were 80.9% for PI-LL mismatch (35.5% LLIF, 64.5% PCO/PSF), 40.5% for pelvic tilt (39.4% LLIF, 60.6% PCO/PSF), and 69.1% for C7 SVA (45.7% LLIF, 54.3% PCO/PSF). Coronal correction of the Cobb angle reached 76.7% (33.1% LLIF, 66.9% PCO/PSF). Significant ODI and SRS-22 score improvements were noted at two years. Predictive thresholds for imbalance were M-SVA 75.3 mm, M-PI-LL 32.5°, and M-PT 35.5°. The 2nd stage PCO/PSF contributes more to correction, and predictive thresholds aid surgical planning, reducing postoperative imbalance for better outcomes.

Advances in adolescent idiopathic scoliosis management

青少年特發性脊柱側彎治療的進展：美國科羅拉多兒童醫院的經驗

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Adolescent idiopathic scoliosis (AIS) management has significantly evolved in recent years, incorporating innovative approaches designed to enhance outcomes while reducing invasiveness and maintaining spinal mobility.

This presentation will introduce cutting-edge advancements in AIS treatment based on my observations and experiences at Children's Hospital Colorado, a leading pediatric spinal deformity care center. The talk will concentrate on three major innovations: **1.** predictive modeling using machine learning algorithms that enhance our ability to predict curve progression and optimize treatment timing; **2.** non-fusion techniques, including anterior Vertebral Body Tethering (VBT), which preserve growth and mobility while effectively managing progressive curves; and **3.** robotic-assisted surgical techniques that improve the precision of instrumentation placement while potentially reducing complications and recovery time.

I will discuss the ongoing challenges in implementing these technologies, including patient selection criteria, tips, and pitfalls. The integration of these advances presents promising pathways toward more personalized and less invasive care for AIS, potentially transforming the standard of care for this significant spinal condition.

My learning journey in early onset scoliosis surgery

早發性脊椎側彎手術治療經驗

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吳冠文

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Early-onset scoliosis (EOS) covers a diverse, heterogeneous range of spinal and chest wall deformities that affect children under 10 years old. With the advent of new biological therapies, clear advances have been made in understanding EOS's natural history, progression, and long-term consequences. In the same way, during the past few decades, technological innovations have also increased the treatment alternatives for EOS patients.

The foci of treatments for EOS have included creating a well-developed thoracic cavity, improving lung volume, and improving pulmonary function. Conservative treatments include bracing, casting, halo-gravity traction, and physiotherapy. Serial casting is the most effective conservative treatment for EOS, but has specific limitations. Surgical treatments mainly include growth-friendly techniques, which are generally classified into three types according to the amount of correction force applied: distraction-based, compression-based, and growth-guided. The distraction-based systems include traditional or conventional growing rods, magnetically controlled growing rods, and vertical expandable prosthesis titanium ribs For EOS patients presenting with sharp deformities in a long, congenital spinal deformity, a hybrid technique, one-stage posterior osteotomy with short segmental fusion and dual growing rods, may be a good choice.

Although the patient's growth potential is preserved in growth-friendly surgeries, a high complication rate should be expected, as well as a prolonged treatment duration and additional costs. In addition, surgical techniques may vary depending on the patients' characteristics, the surgeon's experience, and the actual state of the different country. The lecture included my journey of learning about EOS treatment, including the surgical outcomes, painful experience and management of complications.

Application of structured light combined with deep learning for predicting Cobb angles

結構光技術加上深度學習對於側彎角度量測的運用

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Idiopathic scoliosis is a common spinal deformity in adolescents, though its etiology remains unclear. It causes lateral spine deviation in the coronal plane, accompanied by vertebral rotation, resulting in a three-dimensional curvature. Additionally, kyphosis refers to the forward curvature of the spine in the sagittal plane, and when its normal physiological curvature is lost, it is termed hyperkyphosis. Both conditions can have a significant impact on the physical function and quality of life, making early diagnosis crucial. Current diagnostic methods include scoliosis measurement devices and X-ray imaging. While the former is fast but lacks accuracy, the latter remains the clinical standard despite its radiation exposure.

To overcome the limitations of traditional methods, this study integrates structured light technology with deep learning for 3D contour measurement and Cobb angle prediction. The system projects a structured light pattern onto the subject's surface, captures the deformed stripe images using a camera, and reconstructs a high-precision 3D model based on triangulation principles. The reconstructed data is then analyzed using a custom attention-based neural network for feature extraction and angle regression. This study was conducted in collaboration with the Department of Orthopedics at Taipei Veterans General Hospital, with Dr. Feng leading the clinical trial, recruiting 180 eligible participants.

Experimental results show that for sagittal plane angle prediction, the system achieves a mean absolute error of 2.2° for kyphotic Cobb angles and 1.7° for lordotic Cobb angles, meeting clinical acceptance criteria. The proposed system provides an objective assessment of spinal morphology, assisting clinicians in diagnosis and follow-up, reducing the need for radiographic examinations, minimizing radiation exposure, and improving diagnostic efficiency and accuracy.

Towards generalizable cobb angle measurement: Evaluating a deep learning model across multiple datasets

邁向可泛化的 Cobb 角測量：深度學習模型於跨資料集的驗證與評估

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Scoliosis is a common spinal deformity that can impede adolescent growth. Clinicians assess scoliosis using the Cobb angle, measured from anterior-posterior X-ray images, by drawing lines along the endplates of the most inclined vertebrae. However, this manual process is subjective and can lead to 5 to 10-degree discrepancies due to challenges in vertebra identification and low image contrast. Automating Cobb angle estimation is essential for improving reliability and efficiency while reducing subjectivity. However, existing deep learning models are often trained on localized datasets, limiting their generalizability. Ensuring robust performance across diverse datasets is crucial for real-world clinical applications.

This study integrates YOLOv8 for vertebral detection and Segment Anything Model 2 (SAM2) for precise segmentation. YOLOv8 detects vertebral regions via bounding box prompts, refined by SAM2 to generate segmentation masks. The masks are fitted to the minimum bounding rectangles to locate vertebral corner points, enabling Cobb angle calculation. To evaluate cross-dataset generalizability, the model is trained on 70% of the Taipei Veterans General Hospital (TVGH) dataset, validated on 20%, and tested on the remaining 10% along with the London Health Sciences Centre (LHSC) dataset. No LHSC data is used in training, ensuring an unbiased assessment.

Results show a mean absolute error of 3.7 degrees on TVGH and 4.91 degrees on LHSC, both within the clinically acceptable 5-degree margin. The model's ability to maintain accuracy across datasets with varying image quality underscores its robustness for real-world use. Future research will further validate cross-dataset performance, enhance adaptability to different imaging conditions, and explore domain adaptation and zero-shot learning for improved model transferability in medical applications.

Intraoperative Neurophysiological Monitoring (IONM) in scoliosis correction surgery：A clinical perspective

術中監測在脊椎側彎手術中的實務應用

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Although relatively infrequent, neurological injury may occur in spinal surgery and result in serious postoperative neurological deficits. IONM for spinal surgery has been developed since the1970s to avert these neurological complications.

A range of neuromonitoring modalities is used to improve assessment of nervous system integrity. These include somatosensory evoked potential (SSEP), transcranial motor evoked potential (Tc MEP), free-run EMG and triggered EMG (t EMG). The SSEP and Tc MEP help monitor sensory and motor pathways to guard spinal cord function. Triggered EMG is used to assess proper pedicle screw placement, and free-run EMG provides immediate real-time information on specific spinal roots, and neurotonic discharge occurs secondary to nerve root irritation.

In recent years IONM has become a standard modality used almost universally to improve the safety of scoliosis correction surgery. To ensure patient safety, neuromonitoring services should be provided by a collaborative team including the surgeon, anesthesiologist, and an IONM technologist or neurophysiologist.

In this presentation, we will discuss the application of multimodal IONM to patients undergoing scoliosis correction surgery and share our clinical experience over the past years.

Neuromonitoring technique and practice

神經監測技術與實作

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Practical IONM practice in this session. We will discuss patient preoperative preparation, instrument and cable connection, Signal baseline establishment, anesthesia conditions related to neuromonitoring, interpretation of signal changes during surgery and how to trouble shoot abnormal signal.