



Pedicle Subtraction Osteotomy

**Narrated by Ing-Ho Chen, Director of Dept. of Orthopedics & Honorary
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The onset of ankylosing spondylitis is most common around the age of 20. The disease is still relatively easy to treat in early adulthood where the body is fully matured. The onset for Yang Xiao-Dong was at the age of 12, in early adolescence where the body is still growing. The deformation began as the body still in developing stage was the reason behind Xiao-Dong's 200 degrees bent. The severe deformation also further complicated the difficulty of the surgery.

The Largest Series in Taiwan Using Pedicle Subtraction Osteotomy

For patients with severe spine deformity caused by ankylosing spondylitis, pedicle subtraction osteotomy is the more effective surgical treatment. We performed our first pedicle subtraction osteotomy in 1992, a time when the surgery was rarely discussed in Taiwan. Now, in our Tzu Chi hospitals, we have performed the surgery on over 220 ankylosing spondylitis patients, the largest series in Taiwan and even in the world.

Intraoperative stable positioning is a priority in this surgery. The patient must be held in proper position on the surgical table steadily. Xiao-Dong's body, with over 200 degrees of deformation, had been proven challenging

in this aspect. To accommodate that, the medical team decided to first perform both hip replacement surgeries, replacing the severely bent and rigid joints with artificial hip to reduce Xiao-Dong's deformity by 40 degrees and allow him to stretch his trunk a little further, aiding in positioning on the operation table for spinal surgery in the following step.



One Step at the Time



Xiao-Dong successfully stand up after five surgeries and had a photograph with his attending physician Honorary Supt. Ing-Ho Chen.

Disinfection, incision, osteotomy, replacement are the four basic procedures in a routine hip replacement surgery. In Xiao-Dong's case, however, his hip had shrunk into his pelvis, limiting any leg movements, which, in other words, meant that disinfection and the rest of the procedures were impossible. The surgery was, therefore, divided into two parts: First, in a separate preliminary operation, make an incision, and through the incision, break the hip to mobilize the femur away from the pelvis, and suture the wound; second, the broken femur allows the leg to move unrestricted, which enables the full leg disinfection and standard draping; third, proceed with the regular hip replacement surgery. The surgery reduced the deformity by 40 degrees, allowing Xiao-Dong to extend his legs, reduce the pressure on his abdomen and internal organs, and as result improve organ functions. And then, it was time for the most vital surgery for Xiao-Dong: the spinal corrective surgery.

Although his trunk being extended a little after hip surgeries, Xiao-Dong's spine was still bent by 130 degrees, therefore how to secure him on a surgical table became the first major obstacle. During spinal surgery, the patient is in a lying posture. The support for the body is limited, it is as if the patient is hanged on the surgical table. Such posture, when it comes to surgery, is incredibly risky. A slight mistake can result in cervical fracture and lead to paralysis. To ensure a smooth surgery, the medical



To ensure the surgical table stability and safety during the surgery, Hon. Supt. Ing-Ho Chen and fellow physicians tested it first and asked Xiao-Dong to test it again.

team brought Xiao-Dong to the surgery room the day before the surgery to simulate the entire process. I climbed onto the surgical table as well to test the each surgical posture, to see if the patient is properly secured, if there was any breathing difficulty or if the patient was uncomfortable in any way. Any detail cannot be neglected. I was only satisfied once I was certain that Xiao-Dong could be properly and safely secured.

First Remove, Then Fuse Together

With all the preparation set, it was time for the grand finale: Pedicle subtraction osteotomy. The principle of pedicle subtraction osteotomy is to cut and remove a triangular shape from the bone to allow room for correction.

Osteotomy, correction and implant are three major steps in spinal corrective osteotomy, each with their unique challenges. We first performed osteotomy on the fourth lumbar. First, we remove the lamina to gain entrance to the vertebra, and from that entrance simultaneously extract partial bones from the vertebra and disconnect the rigid vertebral column.



➤ **Dr. Ing-Ho Chen carefully examined Xiao-Dong's skeletal image and physical conditions to measure the degrees of each correction.**

The osteotomy allows the deformed vertebral column to be corrected.

The process of correction demands a great deal of manpower. The surgical staff who are physically fit and the entire nursing staff came to help with the corrective procedure: a group of people secure the patient, a group assist with the pulling, a group pull the bed sheet. Together they lifted Xiao-Dong's upper and lower body up and proceeded with the corrective procedure.

While proceeding with the corrective procedure, one must avoid any damage to the nerve, as well as major arteries like aorta and inferior vena cava. Xiao-Dong's soft tissues, including the skin, muscles, organs, nerves, blood vessels had all adapted to his deformity, to pull the body forcefully is just like twisting a towel and would result in severe consequences such as nerve damage and vascular rupture.

While performing osteotomy on the second lumbar, abnormal nerve signals were detected in Xiao-Dong's right lower limb. Fortunately, with the collaboration of every team member, the abnormality soon disappeared and the surgery proceeded according to plan.

With the osteotomy on fourth and second lumbar completed, the final

surgery was the spinal corrective surgery. The focus was, based on the foundation laid by the first two surgeries, to correct the surgical regions, remove the temporary screws and replace them with permanent ones. Additionally, the bone fragments, which were removed during the first two surgeries and are stored in the bone bank, will be reinserted to fill in the gap and eventually fuse with the rest and provide strong, durable and lasting support to Xiao-Dong's spine.

A total of five surgeries had corrected approximately 140 degrees, with 30 degrees of deformity respectively in the hip and knee joints. The key point of the follow up treatment lies in continuous rehabilitation to enhance muscle strength and avoid joint contracture.

Signature Surgery as International Milestone

What Hualien Tzu Chi Hospital did for Xiao-Dong was reconstruction: physical reconstruction with medical technology and psychological



1

Spinal deformity prior to surgery



3

Second lumbar corrective osteotomy, correct 30 degrees



2

Fourth lumbar corrective osteotomy, correct 45 degrees



4

Second and fourth lumbar readjustment surgery, correct 25 degrees

reconstruction with care and love. We wish that Xiao-Dong can utilize his new body to start a new life, find a job to support himself, and contribute to the society.

Spinal surgery is a major feature of Hualien Tzu Chi Hospital. Pedicle subtraction osteotomy has become a signature surgery of the hospital in treating ankylosing spondylitis. The medical journal mandatory to orthopedic surgeons worldwide - Orthopedic Knowledge has included the surgery in its eighth edition. Furthermore, I was invited to cowrite a chapter on ankylosing spondylitis in the 2009 U.S. textbook "Pediatrics Spinal Surgery". Pedicle subtraction osteotomy has been documented in numerous literature for the past two decades. Its procedures have been standardized. I recommend young orthopedic surgeons who are interested in the surgery to read those literatures and observe experienced surgeons as they operate, in order to master the surgery and benefit their patients.

The result of Xiao-Dong's five surgeries respectively

2013/05/24	Spinal deformity prior to surgery
2013/05/28	Right side hip replacement surgery
2013/06/04	Left side hip replacement surgery, correct 40 degrees.
2013/07/02	Fourth lumbar corrective osteotomy, correct 45 degrees
2013/07/24	Second lumbar corrective osteotomy, correct 30 degrees
2013/08/13	Second and fourth lumbar readjustment surgery, correct 25 degrees

Overall Result

Prior to the surgery, the deformation of Yang Xiao-Dong's spine was 130 degrees, hip joint 70 degrees, a total of 200 degrees. After five surgeries, the spine was corrected by 100 degrees, hip joint 40 degrees, a total of 140 degrees. The 30 degrees in the hip and knee joints respectively can be corrected via continual rehabilitation.