# Surgical Repair of Pars Defects in Spondylolysis

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**Abstract**

Direct repair of the pars interarticularis defect was carried out in 16 spondylolysis patients. There were 8 male and 8 female patients. The site of pars defects involved $L_5$ in 10 cases and $L_4$ in 6 cases. Chronic low back pain was the main symptom, only one patient presented with acute severe back pain. Pars defects were confirmed by oblique views of the lumbosacral spine. The height of the spinous process of the involved vertebra was measured and compared to the above adjacent vertebra. Radiographic fusion of the defects was confirmed by bridging of bone across the pars on oblique views. All the patients except one were treated conservatively prior to surgery. Clinical outcomes were assessed by pre- and post-operative pain, union of the pars defects, functional status and patient verbal rating scales.

The mean follow-up was 36 months, the longest was 7 years. At 2 years follow-up, the overall satisfaction and improvement were reported in most of the patients. There was no functional failure. Hypoplasia of the neural arch was found in 3 patients. There were two non unions, both of them had maldevelopment of neural arches. One symptomatic non union needed resurgery for stabilization.

**Key word :** Surgical Repair, Spondylolysis

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For spondylolysis, there have been many attempts to eliminate pain and to preserve function of the mobile spine by fusing only the pars defects[1-4]. Nicol and Scott[3] passed wire around the transverse process then passed caudal to the spinous process in order to repair the lytic spondylolysis with bone graft. Modification of this technique by passing wires around the screw head can allow a more compressive force across the pars defects. This figure of 8 wiring technique with pedi-

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cular screws was reported to be the strongest to resist anterior posterior translation in biomechanic tests[5]. The purpose of this study was to report the clinical result of the pedicular screw technique.

## MATERIAL AND METHOD

From 1992 to 1998, at the Institute of Orthopedics, Lerdsin Hospital, direct repair of the pars defects using pedicular screw with figure of 8 wiring technique was carried out in 16 spondylolysis patients. There were 8 males and 8 females. The average age was 28.4 years old (range from 22-42 years). All patients presented with chronic low back pain. One male patient had had pain for two months and developed acute severe back pain for one week prior to surgery. On physical examination, all patients had stiffness of the back. Sensory examination and motor power were normal, straight leg raising test was negative in all except the one who presented with acute back pain. AP and lateral views showing no radiologic evidence of concurrent disc degeneration such as disc space narrowing and traction spurs while pars defects were confirmed in oblique views of lumbosacral spine. Hypoplasia of the neural arch was determined by the decreased height of spinous process which was always associated with the height of the lamina. The height of spinous process of the involved vertebra was measured and compared to the cephalad adjacent vertebra on AP view. Maldeveloped spinous process was determined by less than one half or less than one third the height of the cephalad adjacent vertebra. All patients except one were treated conservatively for six months before surgery was considered.

### Surgical technique

From biomechanical study the wiring technique can produce a significant increase in bending stiffness of spondylolytic lumbar segment[6]. The principle of the tension band wiring can provide dynamic compression and can absorb the tensile forces acting on the fracture site. Normally for tension band wiring, one end of the wire loop should pass through bone or through the tendinous structure close to the bone, the other loop is usually passed around the projecting ends of the Kirschner wires. With the current technique, one wire loop is placed around the screw head which can result in a more uniform force, while another loop is placed around the spinous process in which the posterior ligament complex of the spine can act similarly to

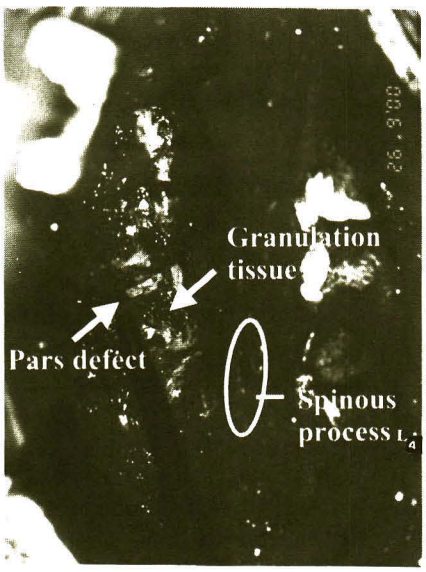



**Fig. 1. Intraoperative photograph showing pars defect and surrounding granulation tissues, spinous process of $L_4$ is seen caudal to the defect.**

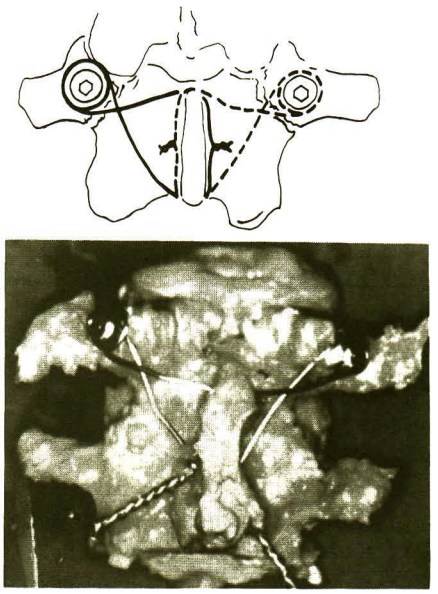


**Fig. 2. Drawing and photograph of pedicular screw fixation and figure of 8 wire - loop technique.**

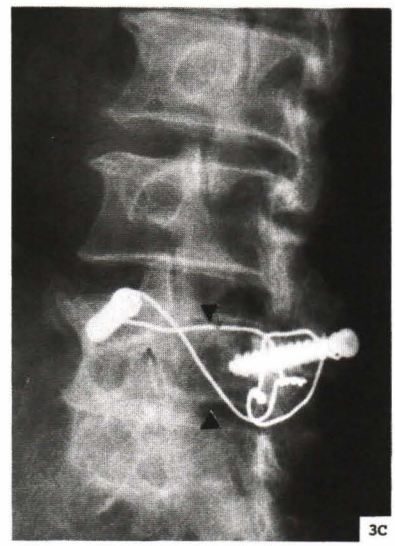


**Fig. 3A, 3B and 3C. Follow-up radiographs at 7 years post-surgery : anteroposterior, lateral and oblique views show bony union of the defects. Please note the height of $L_5$ lamina (3C) compared with the lamina in Fig. 4A (arrow).**

the muscle tendon of the long bone. This modification by crossing the figure of 8 wire loop over the fracture line can provide more compression force on the pars defect.

The patient was placed in the prone position, midline approach was used to expose the affected vertebra. Loosening of the defected segment can be easily identified. Laminotomy was not performed. All fibrous tissues at the non union site were removed and the defected bone was decorticated (Fig. 1). A small amount of fluid was observed to leak out following exposure of the pars defects. AO cancellous screws 40 mm in length were inserted into the pedicles of the involved vertebra. An 18 – gauge wire was looped around the screw head and loosely placed in a figure of eight pattern around the spinous process (Fig. 2). Cancellous bone graft obtained from the iliac crest was placed to bridge the freshened gaps. Stability of the whole segment can be observed following wire-loop tightening.

The patients were allowed to ambulate as soon as possible without any brace or support. Clinical outcomes were assessed by radiologically fusion of the defects on oblique views and functional status. Pre- and post-operative pain[7] were assessed by grading and coded as O-none to occasional pain, 1 – mild, 2 – moderate, 3 – severe or 4 – very severe. Post-operative functional failure[8] was assigned as : out of work or changing work because of back problems; daily narcotic use reported; significant limitations in daily activities to carry groceries, climb stairs, walk, bathe and dress ; being able to work but performing at a reduced level. Patient verbal rating scale[7] regarding satisfaction and improvement were : overall satisfaction with



treatment, much improvement, no change (probably worse) or definitely worse (bad).

## RESULTS

Of the 16 patients, the site of pars defects commonly involved was $L_5$ in 10 cases and $L_4$ in 6 cases. Maldeveloped neural arch was found in 3 patients. Bilateral pars defects were demonstrated during surgery in all patients. The height of the involved spinous process was less than one third and less than one half of the above vertebra in two patients and one patient respectively. At approximately 8 and 14 months, complete bridging of the defects was observed in 10 patients and 4 patients respectively (Fig. 3). Fifteen patients were graded pre-operatively as having severe pain, only one had

Fig. 4A. Pre-operative oblique view showing pars defect of $L_5$ vertebra.

Fig. 4B, 4C, 4D. Post-operative radiographs at 2 years follow-up showing the existing pars defects on lateral and oblique views respectively.

very severe pain. The mean follow-up was 36 months (ranging from 24 months to 7 years) At two years' follow-up, there were two radiographic non unions. Both patients had hypoplastic neural arches and only one patient had symptoms. Occasional pain was reported in 15 patients, one had mild pain. There was no functional failure following surgery. Overall satisfaction was reported in 14 patients while the other two patients perceived themselves as having much improvement. One non-union patient did well for 24 months then gradually developed back and sciatica pain. The L-S spine showed non-union at the defects of the fifth lumbar vertebra (Fig. 4). Reexploration confirmed the diagnosis and stabilization of $L_4$ – $S_1$ segments was done with pedicular screws and bone grafts. One patient returned to his daily job as a worker in the operating room 3 months following surgery. Neither infection nor implant failure was found in the study.

## DISCUSSION

Direct repair of the pars defects with wiring technique for spondylolysis has been reported with successful outcomes[9]. The modified Nicol's technique with tension band wiring principle and pedicular screw fixation can provide more compression across the defects. Pedicular screw and figure of 8 wiring has been shown to be the strongest to resist anteroposterior translation in cadaveric spines[5]. More compression force across the pars defects can be obtained following tightening of the wire-loop. During operative procedure, this stability can be directly observed. Sources of pain in spondylolysis may be due to irritation of the involved nerve roots or the interposed tissue within the pars defect[10] or instability of the loose neural arch[11]. Although overall satisfaction following the repair was obtained in most of the patients, this can not validate the causes of pain in the current study. There were two non-unions following the repair with one patient needing stabilization and fusion. The isthmic defect appears to result from a combination of a hereditary dysplasia of the pars interarticularis and stress imposed on the spine[12,13]. Spina bifida and hypoplasia of the neural arch have been mentioned to be commonly associated with isthmic pars defects[12]. This malformation may contribute to the non-union. Thorough debridement, refreshening and supplemented with more autogenous grafts should be considered for high risk patients who have maldevelopment of the neural arches.

## SUMMARY

Direct repair of pars interarticularis defects by pedicular screw and figure of 8 wiring is a reliable technique. Pain relief, preservation of functional mobile segment of the pain and stability of the defected vertebra can be expected especially in young patients who have no other concomitant source of pain. The maldevelopment of the neural arch was found to be associated with non-union following surgery.

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## REFERENCES

1. Bradford DS, Iza J. Repair of the defect in spondylolysis or minimal degrees of spondylolisthesis by segmental wire fixation and bone grafting. Spine 1985; 10: 673-9.
2. Hambly M, Lee CK, Gutteleling E, et al. Tension band wiring – bone grafting for spondylolysis and spondylolisthesis. Spine 1989; 14: 455-60.
3. Nicol RO, Scott JH. Lytic spondylolysis. Repair by wiring. Spine 1986; 11: 1027-30.
4. Salib RM, Pettine KA. Modified repair of a defect in spondylolysis or minimal spondylolysis by pedicle screw, segmented wire fixation, and bone grafting. Spine 1993; 18: 440-3.
5. Vathana P, Prasartritha T. A biomechanic study of the surgical repair technique of pars defect in spondylolysis. J Med Assoc Thailand 1998; 81: 824-9.
6. Saraste H. Long term clinical and radiological follow-up of spondylolysis and spondylolisthesis. J Pediatr Orthop 1987; 7: 631-8.
7. Simotas AC, Dorey FJ, Hansraj KK, Cammisa F Jr. Nonoperative treatment for lumbar spinal stenosis. Spine 2000; 25: 197-204.
8. Albert TJ, Pinto M, Denis F. Management of symtomatic lumbar pseudarthrosis with anteroposterior fusion. Spine 2000; 25: 123-30.

9. Suh PB, Esses SI, Kostuik JP. Repair of pars interarticularis defect. The prognostic value of pars infiltration. Spine 1991; 16 (Suppl): S445-S448.
10. Schneiderman GA, Mclain RF, Hambly MF, Nielsen SL. The pars defect as a pain source. A histologic study. Spine 1995; 20: 1761-4.
11. Grobler LJ, Novotny JE, Wilder DG, Frymoyer JW, Pope MH. L4-5 isthmic spondylolisthesis. A biomechanical analysis comparing stability in L4-5 and L5-S1 isthmic spondylolisthesis. Spine 1994; 19: 222-7.
12. Amundson G, Edwards CC, Garfin SR. Spondylolisthesis. In : Rothman RH, Simone FA, eds. The spine, 4th edition. Philadelphia : WB Saunders. 1999: 835-85.
13. Szypryt EP, Twining P, Mulholland RC, Worthington BS. The prevalence of disc degeneration associated with neural arch defects of the lumbar spine assessed by magnetic resonance imaging. Spine 1989; 14: 977-81.

# ผลการผ่าตัดเพื่อซ่อมรอยหักตรงตำแหน่ง พาร์ อินเตอร์อาร์ติคูลาลิสในกระดูกสันหลังส่วนเอว

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ผู้รายงานได้เสนอผลการผ่าตัดเพื่อซ่อมรอยหักตรงตำแหน่ง pars interarticularis ของกระดูกสันหลังส่วนเอว จำนวน 16 ราย ผู้ป่วยชาย 8 ราย และผู้ป่วยหญิง 8 ราย ตำแหน่งของรอยหักอยู่ที่ $L_5$ 10 ราย $L_4$ 6 ราย ผู้ป่วยทุกรายมีอาการปวดหลังเรื้อรัง แต่มีผู้ป่วย 1 รายที่มีอาการปวดหลังแบบเฉียบพลัน การวินิจฉัยรอยหักดูจากภาพถ่ายรังสีด้านเฉียงของ L – S spine วัดความสูงของ spinous process จากภาพรังสีด้านตรง (AP view) โดยเปรียบเทียบความสูงของชิ้นกระดูกสันหลังที่อยู่เหนือถัดขึ้นไปหนึ่งระดับ ผู้ป่วย 15 ราย ได้รับการรักษาแบบอนุรักษ์ก่อนเป็นเวลา 6 เดือน ผู้ป่วย 1 ราย มีอาการปวดหลัง 2 เดือนต่อมาปวดรุนแรงเฉียบพลันผู้ป่วยรายนี้ได้รับการผ่าตัด ภายในหนึ่งสัปดาห์ ข้อบ่งชี้ คือปวดหลังรุนแรง เทคนิคการผ่าตัดซ่อมรอยหักคือการคล้องลวดขนาดหมายเลข 18 ผ่านหัวสกรู AO ขนาด 6.5 ความยาว 40 มิลลิเมตร ที่ยึดผ่านกระดูกส่วน pedicle ของกระดูกสันหลังที่มีรอยหัก โดยคล้องเป็นรูปเลข 8 ผ่านมาที่กระดูก spinous process วิธีการประเมินผลคือประเมินอาการปวด, รอยหักที่เชื่อมติดจากภาพรังสี, สถานภาพการทำงานและการให้คะแนนความพึงพอใจโดยผู้ป่วยเอง

สามารถติดตามผู้ป่วยนานเฉลี่ย 36 เดือน (ช่วง 24 เดือน ถึง 7 ปี) ตรวจพบ hypoplasia (กระดูก lamina, spinous process เล็กผิดปกติ) ของ neural arch ในผู้ป่วย 3 ราย หลังผ่าตัด 2 ปี ผู้ป่วยทุกรายมีความพึงพอใจในผลที่ได้รับจากการผ่าตัด มีผู้ป่วยที่รอยหักไม่เชื่อมติด 2 ราย ทั้ง 2 รายมีกระดูก neural arch ที่เจริญไม่สมบูรณ์ (ความสูงของ spinous process น้อยกว่าปกติ) ผู้ป่วย 1 รายที่มีอาการได้รับการผ่าตัดเพื่อเชื่อมยึดกระดูกสันหลังด้วยเหล็กดามที่แข็งแรง ผู้ป่วยอีก 1 ราย ไม่มีอาการปวดหลัง

**คำสำคัญ** : การผ่าตัดซ่อม, รอยหักตรงตำแหน่ง พาร์ อินเตอร์อาร์ติคูลาลิส

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