Clinical Neurology and Neurosurgery 139 (2015) 29–34

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

A minimally invasive approach to defects of the pars interarticularis: Restoring function in competitive athletes

Christopher C Gillis[a,*], Kurt Eichholz[b], William J Thoman[c], Richard G Fessler[d]

[a] Division of Neurosurgery, University of Nebraska Medical Center, Omaha, NE, United States
[b] Department of Neurosurgery, Vanderbilt University, Nashville, TN, United States
[c] Department of Neurological Surgery, The Ohio State University, Columbus, OH, United States
[d] Department of Neurosurgery, Rush University Medical Center, Chicago, IL, United States

ARTICLE INFO

Article history:
Received 14 May 2015
Received in revised form 10 August 2015
Accepted 17 August 2015
Available online 28 August 2015

Keywords:
Spondylolysis
Lumbar spine
Minimally invasive
Spine
Pars interarticularis
Athletic spine injury

ABSTRACT

Objectives: To understand that young athletes have a higher incidence of pars interarticularis defects than the general population. This may be due to an immature spine put under higher stress loads at an early age. Traditionally, surgery was reserved for those who failed conservative therapy, and consisted of open exposure, bone grafting and placement of pedicle screws. This leads to a long recovery period and limited ability to return to competitive sport.

Methods: Four collegiate and professional level athletes, three high school athletes, and one member of the National Guard presented with back pain from spondylolysis without spondylolisthesis. All underwent minimally invasive surgery (MIS) to directly repair the pars defect, for a total of sixteen pars defects repaired in eight patients. Described is an application of a MIS pars repair technique that has not previously been reported, which recreates the normal anatomy rather fusing across a motion segment.

Results: Five patients were discharged the day following surgery and three were discharged on postoperative day 2. Six of the patients returned to their previous level of competitiveness. Two were unable to achieve the same level of play, both of whom failed to fuse the spondylolysis. Patients all initially reported clinical improvement postoperatively and there was overall mean improvement on patient reported outcome measures (SF36 physical and mental component scores, visual analog scale, and Oswestry disability index).

Conclusion: MIS advantages include less muscle tissue disruption and restoration of the natural anatomy. This leads to a more rapid recovery, decreased perioperative pain, minimal blood loss, earlier mobilization and decreased hospital length of stay. Overall this allows the athlete to start therapy earlier and return to competition sooner and at his/her pre-operative competitive level. The described MIS repair technique outcomes are similar to those that have been reported in the literature and have allowed a high rate of return to athletics in high performing patients; critical to their quality of life.

1. Introduction

Elite young athletes (teens to late 1920s) have a higher incidence of pars interarticularis defect than the general population. The incidence in the general population ranges from 3% to 6%, with 80% of them being asymptomatic [10,14]. In comparison, an incidence of 13.9% has been reported in young athletes, with the incidence varying depending on the particular sport activity involved [18,24]. Examples of sports with a higher incidence of pars defects include gymnastics, football (specifically lineman), weight lifting, diving, and wrestling [10,23,24]. In a review of 3132 competitive athletes, Rossi and Dragoni found spondylolysis in 23% of weightlifters, 43% of divers and 30% of wrestlers [24]. In other reviews of the subject, Soler and Calderon [27] found spondylolysis in 17% of gymnasts on reviewing 3152 elite athletes, and Iwamoto *et al.* [12] found spondylolysis in 10.4% of 742 college football players.

The exact etiology of spondylolysis has been extensively studied but remains a subject of ongoing deliberation. It is defined as a defect in the pars interarticularis, and can be either unilateral or bilateral in occurrence. It is likely an acquired defect, occurring due to acute or repetitive microtrauma injury during childhood or

* Corresponding author. Division of Neurosurgery, University of Nebraska Medical Center, 982035 Nebraska Medical Center, Omaha, NE 68198-2035, United States. Tel.: +1 402 559 9611; fax: +1 402 559 7779.
E-mail addresses: chriscgillis@gmail.com (C.C. Gillis), kurt@eichholzmed.com (K. Eichholz), thoman.17@osu.edu (W.J. Thoman), rfessler@rush.edu (R.G. Fessler).

http://dx.doi.org/10.1016/j.clineuro.2015.08.024
0303-8467/

during early adulthood. Evidence to support this includes Baker's prospective study in the 1950s which found the incidence of a lytic pars defect to be 4.4% at 6 years of age, increasing to 6% by the time the population reached adulthood [9]. In addition, if there is any listhesis associated with the pars defect it occurs during childhood or early adulthood and stabilizes [2,9,11]. There may be a congenital weakness present in the pars of susceptible patients that predisposes them to an isthmic spondylolysis when associated with certain activities [9,33]. Alternatively, it may be that an immature spine, placed under supranormal stress at an early age is more prone to develop this type of injury. High-impact activities requiring alternating flexion and extension with repetition may lead to a fatigue or stress fracture of the pars interarticularis. The levels most susceptible to pars defects are L5 (85–95%) and L4 (5–15%) [28].

Recent advances in minimal access techniques have allowed many procedures which traditionally have been performed through an open, muscle dissecting approach to be performed through a muscle dilating approach. Minimally invasive spine (MIS) decompression has been shown in comparison with open laminectomy, to decrease hospital length of stay, postoperative pain score, narcotic requirement, and allow faster mobilization and postoperative recovery time. If this is also true in the spondylolysis scenario, it could translate to faster return to competitive sport in this specific patient population [17]. MIS has also been shown to be more cost-effective than traditional open procedures [1].

In this paper, we describe a novel, minimally invasive procedure which allows direct repair of the spondylolysis, without requiring fusion across a motion segment. This procedure is based on traditional pedicle screw insertion, which is a technique familiar to all spine surgeons. In this way, the patient receives not only the above-mentioned benefits of a minimally invasive approach, but also avoids the deleterious effects of fusion across a lumbar motion segment.

2. Methods

We developed a minimally invasive surgery (MIS) for pars interarticularis defect repair using the Dynesys® cable system (Zimmer Holdings, Warsaw, Indiana). Four collegiate and professional level athletes (2 football, 1 volleyball, 1 hockey), three high school athletes (1 volleyball, 1 track, and 1 football), and one member of the National Guard, presenting with symptomatic spondylolysis without spondylolisthesis, underwent bilateral pars defect repair (total of 16 pars defects). Ages of the athletes at the time of surgery ranged from 16 to 23 years of age. The member of the National Guard was 46 years of age. All patients had failed medical management and were unable to participate in their high impact activities secondary to ongoing pain. Six of the patients had spondylolysis at L5, and two had pars defects at L3. Seven of the patients reported back pain exacerbated by extension. Four patients reported bilateral leg symptoms, which was positional. Disc pathology as the cause of pain was ruled out via MRI (see example in Fig. 1) preoperative injections into the pars defects provided relief of symptoms, confirming the diagnosis. Preoperative imaging consisted of MRI as well as CT and plain X-rays with flexion and extension (see Figs. 2 and 3). The patients were not required to wear postoperative external lumbar orthotic devices. Routine postoperative care included physical therapy, which started within 4–6 weeks of surgery. All patients had postoperative CT and serial plain films (see case examples in Figs. 4–6). Postoperative fusion was assessed by the senior author based on the presence of bony growth across the defect on X-ray and/or CT and lack of motion on flexion-extension X-rays. Patient reported outcome measures were assessed preoperatively and then postoperatively at last follow-up. Patient follow-up was performed by the senior author.

Fig. 1. T2-weighted sagittal cut magnetic resonance image (MRI) of L-spine showing relatively normal disk anatomy at L4-5 and L5-S1 in patient with L5 pars defect.

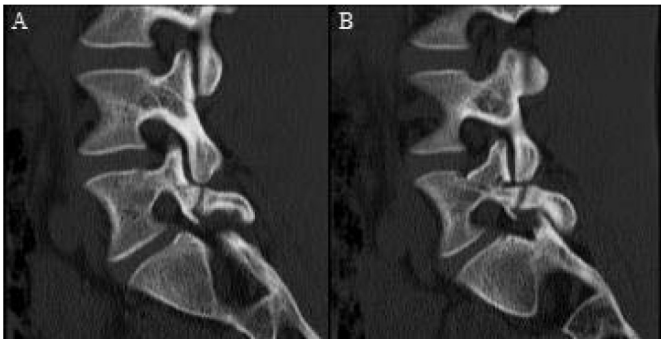

Fig. 2. Pre-operative computed tomography scan (CT) demonstrating defects in the (A) right pars and (B) left pars.

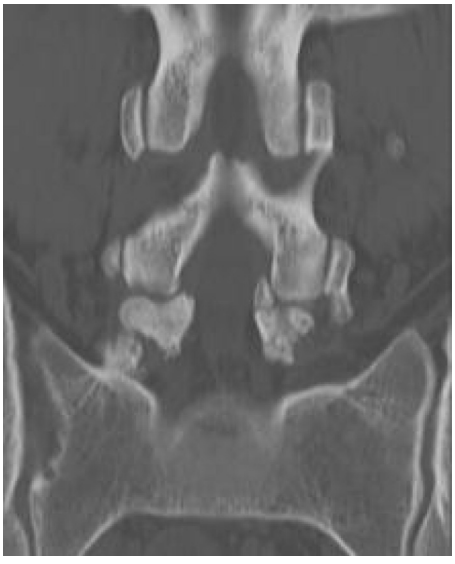

Fig. 3. Pre-operative CT coronal cut image showing bilateral pars defects.