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Editorial

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Current Alternatives for Treatment of Degenerative Spinal Disc Disease

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The improvements in non fusion techniques for the treatment of degenerative spinal discs disease and the other related conditions commenced a new era of spine surgery. This new techniques are different from conventional fusion methods. Fusion methods for treating degenerative segmental disc disease which knowingly impair normal motion by disrupting articular surfaces and locking two or more spinal vertebrae segments as a single unit. Non fusion methods aim to provide stabilization while maintaining the mobility and function of the spine. Many instruments were developed to provide stabilization without fusion. Among them, the application of pedicle screw-based systems is more familiar to spine surgeons. The development of posterior transpedicular dynamic stabilization systems was reviewed in this article.

Low back pain (LBP) is the most frequent clinical problem of the adult spine. Although LBP is a multifactorial disease with mechanical, organic, and psychosocial aspects, one of the most important causes of chronic LBP is thought to be intervertebral disc degeneration [1,2].

Despite numerous research studies, the physiopathology and etiology of disc degeneration remain unknown [3]. The intervertebral discs undergo changes in metabolism, structure, and mechanical function through the ages. The normal ageing process could be accelerated by multiple factors like genetics, nutrition, and life style, excessive and repetitive movements.

The intervertebral disc is composed of the two basic components. The inner part is the nucleus pulposus and the outer part is the annulus fibrosis that is composed of concentric layers of intertwined annular bands.

It is thought that the degenerative processes affect firstly the nucleus pulposus. The nucleus pulposus is a semi-fluid gel comprising 40-60 % of the disc. At birth, the nucleus contains 88 % water; by the age of 75 this has dropped to 65-72 %, the major part of this morphological change occures before early adult life [4]. The reduction of water content is associated with the amount of proteoglycans in the nucleus. Proteoglycan molecules have the property of attracting and retaining water. The proteoglycan content of the disc decreases with ageing and degeneration. This reduction accounts for increase the relative proportion of collagen in both nucleus and annulus. Nevertheless, the nature of the collagen changes: the diameter of the collagen fibrils in the nucleus increases, and its Type II collagen resembles relatively inextensible Type I collagen of annulus [5]. These conditions affect hydraulic properties of the disc, making it more rigid. Actually the disc has a quite dynamic structure with the relative mobility of the nucleus pulposus. The nucleus acted as a ball-bearing and was driven away from the side of movement so, on flexion or extension; it was driven posteriorly or anteriorly in the sagittal plane [6]. Basically stretching of annular fibres is regulated by nucleus movement. In flexion the posterior annulus is stretched and thinned, so that the distance between the nucleus and outer annular fibers are decreased, reverse occurs during extension [7]. In the normal disc space whatever position the spine, the nucleus pulposus and annulus fibrosus work in coordination, the load is transferred over the whole end plate and vertebrae. However in a degenerate disc where the load is transferred to the vertebrae depends on the position of patient. When they bend, their load is taken by front of the vertebrae and as they bend and lift, there will be a great increased focal load. This abnormal load distribution across the disc space is a cause of chronic low back pain by theoretically [8]. Many patients have already expressed complain of postural or positional pain as a prevailing symptom [9]. Lack of relief of low back pain postoperatively may be a result of failure to rectify abnormal load transferring patterns in the disc space [10].

In 1980s, it was thought that the pain at a symptomatic motion segment was originated from abnormal movement; stopping movement would, therefore, cure pain. For this reason fusion has been widely performed and has been the accepted standard surgical treatment option in painful lumbar degenerative disc disease for a long time. The numbers of these procedures increased exponentially in the 1990s. Posterior fusion was combined with anterior fusion finally "360°" fusion techniques have been used to treat chronic LBP. More rigid metallic instruments were used to enhance the fusion rates. Although successful fusion may be achieved in a high percentage of cases, it fails to provide good clinical results in nearly half of the cases. Additionally, fusion may accelerate degeneration of adjacent segments [11]. Disappointment of the clinical results were fueled the search for new alternative treatments [12-17].

Since the 1990s, the recognition that stopping movement might not be mainstay for curing back pain and the necessity deal with a problem of load transferring was emerged the general term dynamic stabilization. Many surgical implants were designed to provide the lumbar dynamic stabilization. These devices were classified as anterior dynamic systems (total disc prosthesis) and posterior dynamic systems (transpedicular screw based and interspinous devices) [18]. Transpedicular screw based dynamic systems are divided into three category as screw rigid-rod dynamic, screw dynamic-rod rigid and both of them dynamic systems.

The Graf ligament system (SEM Sarl, Montroge, France), which was invented by Henri Graf in 1992, was one of the first such devices. Graf theorized that the origin of chronic low back pain is abnormal rotational motion, therefore, the device aimed to control rotatory movement by locking the lumbar facets in the extended position

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[19]. This screw rigid- rod dynamic system consists of nonelastic band as a ligament to connect pedicle screws across the segment to be stabilized, to lock the segment in lordosis. The system was intended to redistribute the transmission pathway for load across the painful disc by providing posterior tensioning. Although numerous studies reported positive outcomes [20-22], clinical outcomes with the system are similar to those after fusion [23,24].

The Dynesys Dynamic Stabilization System (DSS) (Zimmer Spine, Inc., Warsaw, IN, USA), which was develeoped by Dubois [25] . This system represents a further development of the Graf system. Dynesys system consisting of titanium alloy pedicle screws connected by a tension band with a plastic tube (Figure 1). In flexion, motion is controlled by tension on the band, while during extension the plastic tubes act as a partially compressible spacer, thereby allowing limited extension [26,27]. Dynesys DSS seems to have succeeded some of goals of dynamic stabilization, namely, control of neutral posture, controlled motion, and unloading of the posterior portion of the disc [28]. Although initial studies were encouraging, some studies have reported lordosis and load-sharing problems with this system.

Other recently developed dynamic rod- rigid screw systems include the DSS I and DSS II. The first generation DSS I was a C-shaped titanium spring rod and second generation DSS II was a α-shaped titanium rod.

The fulcrum assisted soft stabilization system (FASS) (Neoligaments, Leads, UK) was designed as an improvement over the Graf system [29]. FASS consisting of high density polythene rod as ful crums and rubber "O" rings as ligaments. In the FASS, a fulcrum was placed in front of the posterior ligament, which meant as the ligament was tightened, the motion segment did not go into extension, but the disc height was increase and the disc was unloaded.

The total posterior element-replacement system (TOPS) was designed to replace the entire posterior elements after facetectomy. The implant is composed of bilateral pedicle screws, connected with 2 crossbars in the transversal plane. The crossbars are joined together by an elastic disc element capable of transmitting tensile and compressive loads [30].

The head of the screw was chosen as dynamic part in the Cosmic and Saphinas screws. The Cosmic screw that first dynamic hinged

Figure 1: 35 years old, female, suffered severe back pain attack often (a) MRI showed mild degeneration and annular rupture of L4-5 disc (b) Preop X-Rays (c) Dynesys is applied to and the patient is painless since after the operation.

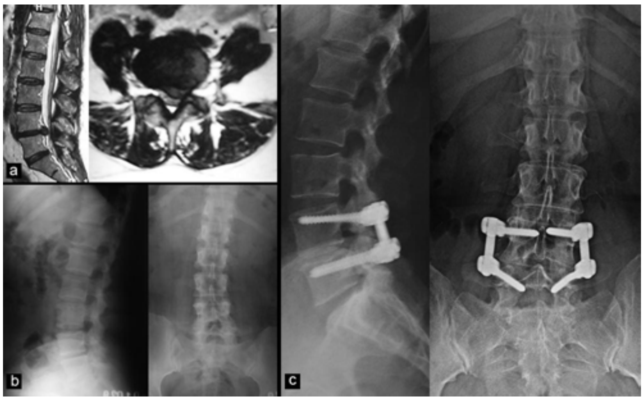

Figure 2: 42 years old, female suffered severe back pain and left leg pain (a) MRI showed a wide based herniation of L4-5 (b) Preop X-Rays (c) Cosmic system is applied to the patient and the patient is painless since after the operation.

Figure 3: 58 years old, female suffered severe back pain attack every 3 months (a) MRI showed midline annular rupture with mild degeneration (b) Preop X-Rays (c) Saphinas system is applied and the patient is painless since after the operation.

screw (Cosmic, Ulrich GmBH & Co. KG, Ulm, Germany) was designed and developed by Strempel in 1999 [31] (Figure 2). The Saphinas screw (Medikon AS, Turkey) was designed according to the principles of the cosmic screw by Ozer [32]. The hinged screw provides for a adequate motion and load sharing between the implant and the spinal column and at the same time prevents any rotation and translational instability [33] (Figure 3). The results of study using the Saphinas screw show that lomber transpedicular dynamic stabilization appears to be a good alternative to rigid stabilization [32].

Restoring the load transmission patterns in the degenerated intervertebral disc space plays a central role in the treatment of low back pain. Therefore the treatment alternatives are changing. However the irreversible procedures like traditional fusion should probably be considered only when the lesions themselves are also irreversible. Owing to the advances of dynamic reconstruction of spine that will soon be the new gold standard in the treatment of degenerative spinal disc disease.

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