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Original Article

Clinical study on the treatment of sequestrated lumbar disk herniation by feng's spinal manipulation

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Abstract: Objective: To evaluate the clinical efficacy of treating sequestered lumbar disc herniation (SLDH) with Feng's spinal manipulation. Methods: 112 patients (52 males, 60 females) with SLDH were treated by Feng's spinal manipulation. The clinical outcome was evaluated by using the JOA (Japanese Orthopaedic Association) score and Feng's spinal assessment system for SLDH. The MRI sagittal index (SI) of lumbar disc herniation was measured and compared between pre- and post-treatment. Result: The scoring of patients' subjective and clinical symptoms were improved significantly before discharge as well as on follow-up ($P<0.05$). There was no statistical difference in the SI between pre- and post-treatment. However, there was significant difference in SI between pre-treatment and follow-up. Conclusion: The leading pathologic change in SLDH is single/multiple vertebral subluxation. Feng's spinal manipulation can correct the vertebral subluxation which leads to spinal column stability. The clinical signs disappeared with the recovery of spinal column stability.

Keywords: Lumbar disc herniation, sequestered lumbar disc herniation, Feng's spinal manipulation

Introduction

Sequestrated lumbar disc herniation (SLDH) is a special pathological type of lumbar disc herniation. Intercalated disc tissue leaves intervertebral space and sequestrates in the epidural space. Sequestrated intercalated disc tissue mainly refers to nucleus pulposus and endplate tissue. MRI examination is a reliable method [1, 2] for clinical diagnosis of intervertebral disc subluxation. It is generally believed that SLDH presents severe clinical manifestations and needs to be treated with surgery as early as possible. Prof. Tianyou Feng developed a technique termed Feng's spinal manipulation [3] in the 1970s and proposed that slight displacement of a single or several vertebrae is the main pathologic change of lumbar disc herniation, and disequilibrium between intrinsic and extrinsic vertebral column is the theoretical foundation of lumbar disc herniation. The spinal (along the longitudinal axis) movement manipulative reduction, which is the essence of Feng's spinal manipulation (hereafter referred to as Manipulation) for reducing vertebral displacement, is the main therapeutic avenue. We designed this clinical study by treating 112 sequestrated lumbar disc herniation patients with Manipulation and had satisfactory results.

Information and method

All of the patients in this study agreed to participate in our investigation and gave written informed consent. The study and consent were approved by the ethical board of the institute of Air Force General Hospital of PLA and complied with the Declaration of Helsinki.

Clinical information

112 patients, 52 males and 60 females, with age ranging from 21~65 years old with an average of 36.28 with SLDH were chosen. Clinical manifestations were, lumbosacral pain or/and lower limb pain on the affected side. Physical examination: four physical signs [4] elicited on palpation on lumbar region with both thumbs, such as deviation of the spinous process of the affected vertebra to one side.

Diagnostic, inclusion and exclusion criteria

Diagnostic criteria were based on a history of lumbar-leg pain accompanied by radiating pain along Sciatic nerve in *Treatment of Soft Tissue Injury with Traditional Chinese and Western Medicine.* Four physical signs elicited on palpation of the lumbar region with both thumbs, such as deviation of the spinous process of the affected vertebra to one side. MRI before treatment shows sequestrated lumbar disc herniation.

Inclusion criteria: young and middle-aged people, male or female with SLDH.

Exclusion criteria: Sequestrated lumbar disk herniation patients' combined with urinary retention (one case at out-patient service, which was suggested to be treated with surgery): lumbar disc herniation patient without sequestration; patient's with tuberculous spondylitis or tumors; patient's who had received open or minimally invasive surgery that may have changed the regional anatomy and patient's who suffer from psychological issues that hinder treatment.

Observation and evaluation standard

Observation: 1. Medical history features that were recorded included acute or chronic onset, lumbar-leg pain or dysfunction characteristics etc.; 2. Before treatment, post-treatment and during follow-up, photos of patients inanteposition by standing bare feet and left- and right-side lateral bending; and of lateral projection by standing in a forward bent posture and backward extension, as well as straight leg raised position. The details are as follows: a. lumbar type characteristics [5]; b. to record and measure movement range of lumbar vertebra by forward bending, backward extension and left and right-side lateral bending, and angle of straight leg raising using Adobe Photoshop; c. MRI scan of the lumbar region at pre-treatment, post-treatment and during follow-up. Equipment: Siemens Avanto 1.5T magnetic resonance imaging with spine matrix. Scan method sequence and parameters: sagittal view T1WI, T2WI, fast spin echo sequence, scan range: from T11-S5 plan; axial view T2WI, fast spin echo sequence, scan range: from inferior margin of vertebral pedicle to superior margin of the next vertebra, which is parallel to the intervertebral space, at least to scan the next 3 intervertebral discs. Coronal view T2WI, 3D gradient echo water-excitation sequence, scan range: from anterior margin of vertebral canal to spinous process. To measure sagittal diameter index (SI) at same level by MRI sequestrated herniation during follow-up.

Evaluation standard: Evaluation of subjective and clinical symptoms and signs refers to JOA (Japanese Orthopedic Association) score [6, 7] and Feng's spinal assessment system for SLDH [4]: including subjective symptoms, such as lower lumbar pain, lower limb pain or numbness, walking ability etc.; straight leg raising test on affected side; spine movement condition (see **Table 1**), as items for clinic comprehensive evaluation. The lumbar type evaluation standard: 5 points for normal condition, 4 points for type I, 3 points for type II, 2 points for type III and 1 point for type IV. 4 cases have symptoms of cauda equina stimulation or paralysis (frequent micturition, crissum numbness), with which 1 point will be subtracted from the final score.

Treatment

Principle and methods of treating lumbar intervertebral disc protrusion by Feng's spinal manipulation (4): take spinal (along the longitudinal axis) movement manipulative reduction as principal, combed with light and handy, but accurate manipulation for tendon-relaxation, tendon-regulation, abirritation etc. The affected region is then reduced to its normal position (or) compensatory anatomical position. This treatment of the variation in anatomical position is combined with treatment of aseptic inflammation. The intrinsic and extrinsic dynamic equilibriums of the vertebral column is re-established and appropriate rest following manipulation and functional training are then introduced. The patient is treated using Manipulation once a week during hospitalization, and facet joint of affected vertebrae are treated with blockage if necessary. If injury is at the stress point of vertebra, or on piriformis, or superior clunial nerves, or on any location at lumbar and buttock region which rarely suffers injury as determined by palpation, manipulations of tendon-relaxation, tendon-regulation, abirritation or blockage. are used as treatment. Medication: prednisolone injection 25 mg + Lidocaine 2 ml. The average hospitalization period is 25.8 days (7~59 days). Clinical cure

Table 1. Evaluation of Subjective and Clinical Symptoms

Points	5	4	3	2	1	0	-1	-3	-6
Lower lumbar pain			None	Frequent slight pain	Occasional severe pain	Frequent or continuous severe pain			
Lower limb pain or			None	Occasional slight pain	Frequent slight pain or occasional severe pain	Frequent or continuous severe pain			
Numbness gait			Normal	Starts to feel pain, numbness or muscle weakness after walking for more than 500 m	Pain, numbness or muscle weakness cause patients can walk less than 500 m	Pain, numbness or muscle weakness cause patients can walk less than 100 m			
Straight leg raising test				Normal	30° to 70°	Less than 30°			
Abnormal movement				normal	Slight muscle weakness (Grade 4)	Significant muscle weakness (Grade 3-0)			
Lumbar type	Normal	Typel	Type II	Type III	Type IV				
Vertebral column movement				No restriction on movement	Medium movement restriction	Severe movement restriction			
Cauda equine						Normal	Crissum numbness, frequent micturition	Slight Urination difficulty	Severe Urination difficulty

Table 2. Comparative Results of Comprehensive Clinical Evaluation and Imaging Items Observed Among Pre-treatment, Post-treatment and Follow-up

Observed items	Case No.	Pre-treatment	Post-treatment	During follow-up	F	P
Clinical evaluation	112	12.94±4.53	21.40±1.62	23.51±0.67	446.08	0.000
MRI SI value	112	0.61±0.14	0.58±0.15	0.31±0.19	116.22	0.000

ANOVA for repeated measurement was used, Clinical evaluation between any two stages, P=0.000. SI value, pre-treatment and post-treatment, P=0.144, Pre-treatment and follow-up, P=0.000, post-treatment and follow up, P=0.000.

Table 3. Curative effect comparison between acute-onset subgroup and chronic-onset subgroup

Group	Case No.	At discharge	At follow-up
Acute-onset subgroup	33	9±4.16	11.33±4.39
Chronic-onset subgroup	75	8.23±3.96	10.23±4.34
Z		-1.143	-1.413
P		0.253	0.158

The curative effect at discharge = the score after treatment - the score before treatment; the curative effect at follow-up = the score at follow-up - the score before treatment; both the curative effect at discharge and the curative effect at follow-up were not normally distributed in the chronic-onset group, and Mann-Whitney test (non-parametric test) was used.

standard: Deviated spinous process is eliminated as determined through examination by palpation, and physiological or compensatory curve has recovered. Lumbar and lower limb pain has diminished, and any obstruction to movement has been abolished or movement has significantly improved.

Statistical analysis

SPSS 16.0 statistical software package was used to analyze data. Repeated measurement of ANOVA for quantitative data from self-control design was adopted and P<0.05, was determined to be statistically significant.

Results

Medical history features

Sequestrated lumbar disc herniation in the group can be divided into four categories according to medical history: 1. An or no incentive is associated with, and with sudden onset. Patients suffer from severe pain in the lumbar region and lower limbs. Lower limb pain is often diffuse and affects the entire limb with bursting and bearing down pain, to the extent that the patients can't stand by themselves. During the early stage, lying on the back and non-steroidal medication have little palliative effect and the patients have difficulty taking care of themselves. 33 cases were of this type which accounts for 29% among which, some patients suffer from symptoms and signs of nerve root paralysis and/or acute cauda equina injury. 4 cases in the group, which account for 3.5%, suffer from muscle degeneration on the affected limb, including foot drop. Another 2 cases suffered from frequent micturition. 4 cases, which account for 3.5%, suffered from sellar region numbness and slowness of anal reflex. 2. Lumbar and lower limb pain is chronic and patients can usually take care of themselves. Clinical manifestations of bulged or protruded lumbar disc herniation are similar. There are totally 75 cases of this type, which account for 66%. 3. The patients have intermittent claudication, and can't sand or walk for more than 5 minutes with sellar region bursting accompanied by bearing down pain and numbness. Lying on the back shows rapid palliative effect. Only 1 case is of this type, which accounts for 0.8%. 4. The patients suffer with lower lumbar pain are easily fatigable, but can still work. 3 cases are of this type, which accounts for 2.6%.

Evaluation of subjective and clinical symptoms and signs

See **Table 2** for clinical comprehensive evaluation results on subjective symptoms, angle of straight leg raising test on the affected side, vertebral column movement, and lumbar condition. The tables demonstrate that clinical scores increase significantly following Manipulation treatment compared with those before treatment, (P<0.05). Clinical scores increase significantly during the follow-up compared with those before treatment, (P<0.05).

Imaging results

MRI SI values didn't change significantly before and after manipulation treatment (P>0.05). While MRI SI values change obviously during follow-up and before manipulation treatment (P<0.05), differences have statistical meaning. See **Table 2**.

Table 4. Curative effect comparison among patients of different age stages

Age stage	Case No.	At discharge	During the follow-up
20-29	11	7.73±3.69	10.18±4.92
30-39	67	8.52±4.14	10.54±4.37
40-49	29	8.41±4.34	10.45±4.53
>50	5	9.6±4.98	12.60±4.72
X^2		0.542	1.823
P		0.910	0.610

Note: The curative effects were not normally distributed at discharge when the age stages were 30-39, 40-49 and >50, Kruskal-Wallis test (nonparametric test) was used; The curative effects were not normally distributed among patients of different age stages at follow-up, and the Kruskal-Wallis test (non-parametric test) was used.

Therapeutic effect

Therapeutic effect was evaluated according to the following standard: Superior, 20~24 points, absence or significantly diminished pain, patients can return to their former job or study following discharge; Good, 14~19 points, lumbar and lower limb pain is significantly diminished, patients can take care of themselves, rehabilitation training is still needed following discharge; Poor, below 12 points, pain is not diminished and patients' can't take care of themselves. 95 of the total 112 cases in the group ranked in the superior level, 17 cases ranked in the good level and none in the poor level. Follow-up: All the cases were followed up for an average period of 7.4 months (3~32 months). Clinical evaluation during follow-up demonstrated that all patients ranked in the superior level. All patients returned to their former jobs or school. There was no difference on curative effect between acute-onset subgroup and chronic-onset subgroup neither at discharge nor at follow-up. See **Table 3**. There was no difference on curative effect among different age stages neither at discharge nor at follow-up. See **Table 4**. MRI SI values, during follow-up, changed significantly compared with pre-treatment values ($P<0.05$).

Discussion

Reason for sequestrated lumbar disc herniation nucleus pulposus sequestrating spinal (root) canal

Mixter et al., [8] in 1934, were the first to identify that lumbar disc herniation is the main cause of ischialgia. Sequestrated lumbar disc herniation is the most serious pathological type of lumbar disc herniation. It means that fragments of the lumbar disc leave the spinal space and move beneath the posterior longitudinal ligament, or rupture the posterior longitudinal ligament or pass through the lateral posterior longitudinal ligament and stay dunal [9, 10]. MRI is a reliable examination method to diagnose sequestrated lumbar disc herniation, and enhanced MRI can be used if necessary. Most authors [11-15] think that patients with sequestrated lumbar disc herniation often suffer serious nerve root injury and injure the cauda equina. Long-term nerve root compression may cause severe limb dysfunction and would require surgical correction at the earliest.

All patients in the study underwent lumbar MRI scan to confirm the diagnosis of SLDH. The patients were then divided into four categories ranging from mild to severe according to their clinical presentation, degree of pain and functional ability.

About 1/3rd of the patients had sudden onset, or sudden change from chronic to acute lumbar and lower limb pain. The lower limb pain often diffused to affect the entire limb and was of either bursting or bearing down type. Patients suffering this type of pain could not stand without supporter lie down on their back. Non-steroidal medication had little palliative effect during the early stage and patients needed assistance to perform daily functions. A small number of patients also demonstrated symptoms and signs of cauda equina injury or muscle degeneration of the affected limb or even foot drop. Imaging data demonstrated that some of the patients who had a history of lumbar and lower limb pain had lumbar disc bulging or slight protrusion. MRI shows that the protrusion level of nucleus pulposus increases, which sequestered in the spinal canal. These clinical evidences support the fact that protruded nucleus pulposus mechanically or chemically stimulates nerve root or cauda equina or could cause autoimmunity. However, through bed rest or general symptomatic treatment, lumbar and lower limb pain or dysfunction can be relieved within two weeks. If accompanied by cauda equina injury or foot drop, the patients present with acute lumbar and lower limb pain that occur simultaneously or in a short period of time. It shows that humans have tolerance and adaptive ability to combat acute sequestrated nucleus pulposus.

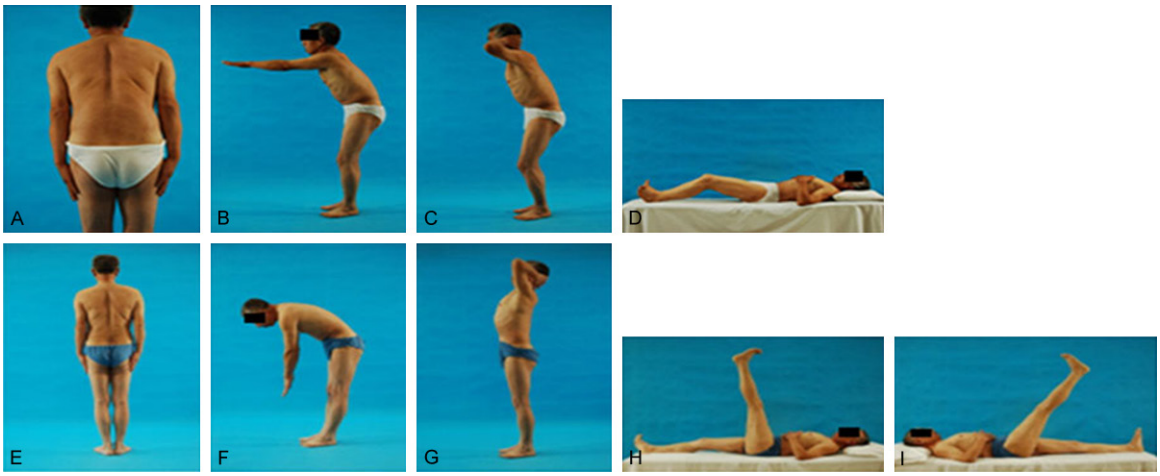

Figure 1. Lumbar function of the patient pre-treatment and post-treatment. Lumbar function of the patient was restricted during standing, flexion, extension and straight leg raising before treatment (the first four pictures). Lumbar function of the patient improved during standing, flexion, extension and straight leg raising after treatment (the latter five pictures).

More patients in the study showed chronic lumbar and lower limb pain, and the clinical manifestation showed no significant difference with bulged or protruded lumbar disc herniation. This correlates with observations made by Mohamed M [10].

3 patients had more protruded nucleus pulposus sequestrating in the spinal canal. However, the patients only manifested with aching pain in the lower lumbar region, i.e. like lumbar muscle strain, which had no effect on their normal work and life. This shows that compensatory ability ofthe patients to nucleus pulposus prolapse may be connected with other factors such as the speed of herniation into the spinal canal. For chronic herniation, this compensatory function becomes more complete.

Patients who suffer from sequestrated lumbar disc herniation have diverse clinical manifestations and the degree of severity is irrelative to the level of protrusion of the sequestered disc. Clinical manifestations do not progressively deteriorate. This means that the sequestrated nucleus pulposus is the pathologic basis of pain or nerve dysfunction, but is not the only factor determining the clinical manifestations.

Slight displacement of a single or several vertebrae and sequestrated lumbar disc herniation

In 1975, Prof. Tianyou Feng proposed that slight displacement of a single or several vertebrae is the main pathological change of lumbar disc herniation. Displacement of a single or several vertebrae is a kind of slight displacement along 6 degrees of freedom in 3D space. Neither clinical, visual nor imaging examination could determine the diagnostic standard. Prof. Tianyou Feng created Feng's "Four Lines" palpating method on the spinous process which established a unified standard for diagnosis of displacement of a single or several vertebrae. Prof. Feng also established the following new standards to diagnosis of lumbar disc herniation: patients have medical history of lumbar and lower limber pain, and with palpation method, the following "four physical signs" are elicited in the lumbar regions: 1. the position of the spinous process of the affected vertebra is deviated to one side; 2. the two interspinous spaces above and below the affected vertebra are uneven (one being longer than the other); 3. there is tenderness on pressing lateral to the spinous process of the affected vertebra or is accompanied by radiating pain to the limb; 4. a longitudinal separation and thickening of the supraspinous ligament (or accompanied with the interspinous ligament) of the affected region with marked tenderness. Feng's Spinal Manipulation, which uses spinal (along the longitudinal axis) movement manipulative reduction as the principle, is used for the treatment.

Through palpation, displacement of a single or several vertebrae is found at the sequestrated lumbar disc herniation region of the 112 patients in this study. Satisfactory effect was

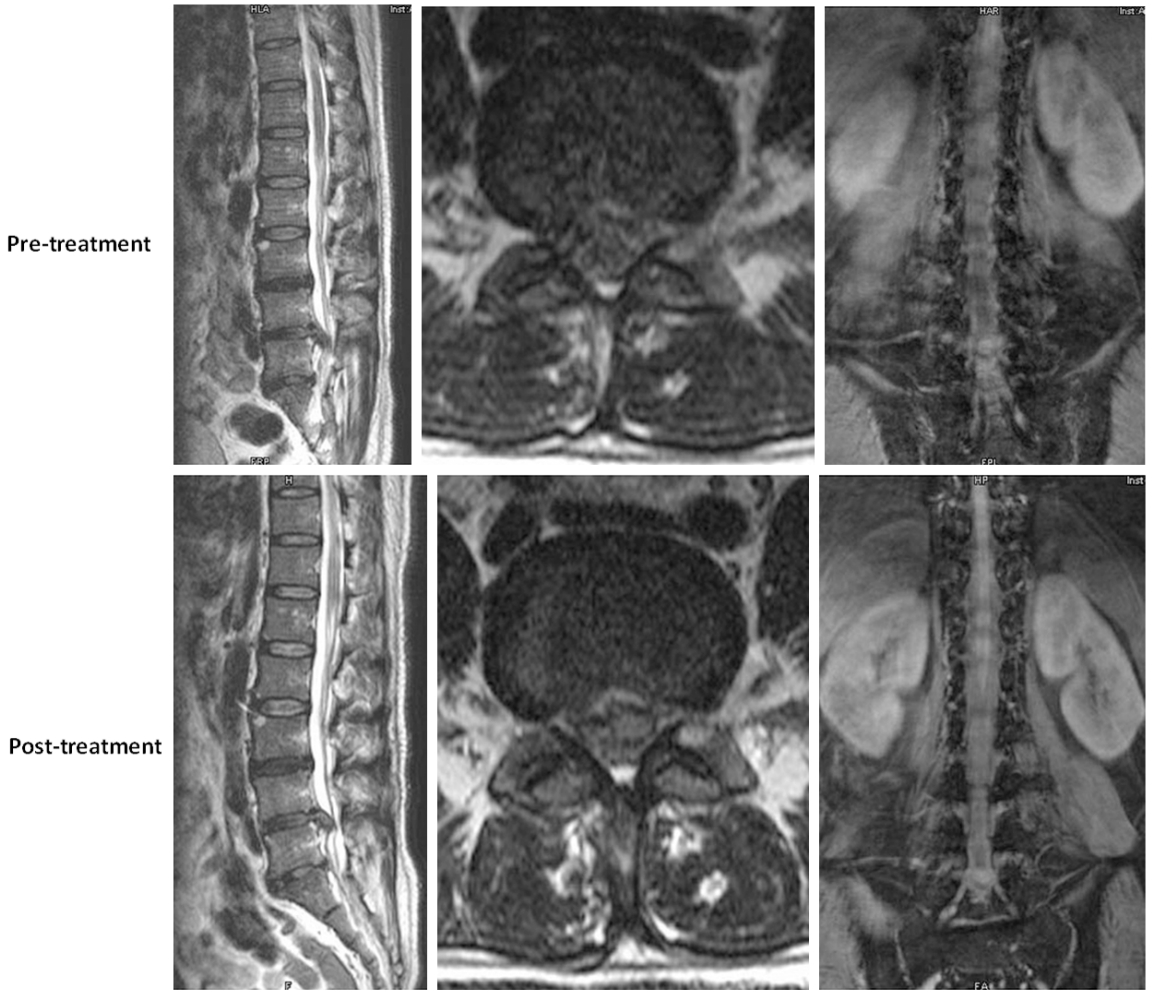

Figure 2. MRI of the patient pre-treatment and post-treatment. Magnetic resonance images showing L4-5 lumbar disc with 10 mm sequestrated protrusion before treatment (the first three pictures), and no significant changes occurred after treatment (the latter three pictures).

achieved by Feng's Spinal Manipulation, which uses spinal (along the longitudinal axis) movement manipulative reduction as the principle and is used to reduce displacement of a single or several vertebrae.

After manipulation is used to reduce the displacement of the affected vertebrae, intrinsic and extrinsic dynamic equilibrium of the vertebral column is re-established; rotation and lateral bending of lumbar vertebrae is improved or completely recovered; lumbar deformity is improved or completely corrected; clinical manifestations are also improved or recovered accordingly. Take one typical case as an example. (See **Figure 1**). A 56-year-old male patient suffers from severe pain of the lumbar region and both lower limbs for 15 days, with difficulty in walking, standing and sitting. He cannot lie on his back or in compulsive position, but with normal urination and defecation. Treatment such as dehydration, non-steroidal medication, traction etc. had been used at a local hospital, but with little effect. MRI shows 10 mm sequestrated protrusion of L4-5 lumbar disc, with compressed dural sac,a narrow spinal canal and a SI of 0.63 (**Figure 2**). Physical examination: revealed a reversed lumbar curve and lateral deviation of the buttock. The "four physical signs", such as the position of the spinous process of L4 and L5 was deviated to one side, were found through palpation method. Clinical evaluation revealed a score of 2 points. Spinal (along the longitudinal axis) movement manipulative reduction was used to reduce L4, L5 displacement. Displacement of L4, L5 is disap-

peared after hospitalization for 41 days. Lumbar curve was recovered and the lateral deviation of buttock was completely abolished. Clinical manifestation improved significantly and the score improved to 21 points. Re-examination by MRI revealed no significants change in the protrusion of the sequestrated nucleus pulposus with a SI of 0.62.

The patients in the study underwent MRI before and after manipulation andthe results showed that the SI value of the protruded nucleus pulposus had no significant change before and after manipulation, among which half of them demonstrated a decrease while 1/3rd showed an increase. That means instant or/and recent clinical manifestation of sequestrated lumbar disc herniation was significantly improved or recovered through manipulative method was due to the vertebrae displacement of affected vertebra was reduced, and equilibrium between intrinsic and extrinsic vertebral column was recovered, but not rely on the disappearance or diminishment of protruded nucleus pulposus. After treatment, the changes of nucleus pulposus sequestration in the spinal canal after reduction of single or several vertebrae was more likely the result of re-establishment of equilibrium between factors which affect the equilibrium between intrinsic and extrinsic vertebral column, such as lumbar disc, facet joint, ligament and paravertebral muscles.

All the patients in the study only perform corresponding functional training following the doctor's advice after treatment without any other treatment and the average follow-up period is 7.4 months (3~32 months). MRI SI values following hospitalization and pre-treatment were not significant ($P>0.05$), while MRI SI value during follow-up decreased significantly compared to that before treatment, ($P<0.05$). 26 patients' with sequestrated nucleus pulposus were completely corrected and 57 patients demonstrated a decrease in SI values, which accounts for 74%. Using manipulative methods to treat sequestrated lumbar disc herniation cannot correct the protruded nucleus pulposus. However, displacement of vertebrae is reduced and intrinsic and extrinsic vertebral column is reestablished. Thus on one hand, pain and functional disturbance is relieved or eliminated, while on the other hand a stable environment is created to absorb and stabilize the protruded nucleus pulposus, increasing the absorption opportunity to protruded nucleus pulposus. Following the absorption or reduction of sequestrated protruded nucleus pulposus, compensatory space is increased. Thus with corresponding functional training, better clinical manifestation can be achieved. Reduction of the sequestrated nucleus pulposus has significant positive effect to patients' psychology.

Influence of disequilibrium between intrinsic and extrinsic vertebral column to clinical manifestation of sequestrated lumbar disc herniation

Feng's spinal manipulation to cure sequestrated lumbar disc herniation was used to mainly reduce displacement of affected vertebrae, and also pay attention to the treatment of factors that affected intrinsic and extrinsic equilibrium of the vertebral column. Slight displacement of the affected vertebrae and compression of protruded nucleus pulposus to the nerve root cause patients' to suffer with lumbar and lower limb pain and lumbar instability, and could even change their center of gravity. To keep balance, relieve or diminish compression of the nerve and blood vessel, and to mitigate pain, a series changes could occur following a "4-step" regulation like lateral deviation of buttock. Compensatory equilibrium formed at this time is not a complete one or a kind of overcompensation. Thus vertebral column becomes a stress point, which turns as a base of new pathologic change. If angulation of lumbar curve forms at the upper lumbar region, stress point mostly is at the transverse process of L2 or L3. If angulation of lumbar curve forms at thelumbosacral region, stress point mostly is at the piriformis muscle attachment, which is at the end of the femoral greater trochanter. Patient feels tenderness at the point of stress as elicited by palpation. Patients suffer from lumbar and buttock pain or lumbar and lower limb pain and sometimes the pain could be severe. However, patients' can hardly point out the exact location of pain. Light and handy, but accurate manipulations of tendon-relaxation, tendon-regulation, abirritation etc. can be used at the point of stress, or blockage treatment if necessary, to relieve the pain. Following manipulation, most symptoms and signs reduce significantly. Manipulation facilitates the stability for reduction of single or several vertebrae, and

ensures the intrinsic and extrinsic equilibrium of the vertebrae column.

At later stage of treatment, due to contracture of affected capsular ligament, shorting of hamstring muscles, stiffness or weakness of paravertebral muscles, functional training is necessary.

Conclusion

Protruded nucleus pulposus sequestering in the vertebral canal is the pathologic base of sequestrated lumbar disc herniation and clinical manifestations show corresponding characteristics. Displacement of single or several vertebrae is the decisive factor of onset. Through manipulations, displacement of single or several vertebrae was reduced, anatomical or compensatory position was recovered and intrinsic and extrinsic equilibrium factors of the vertebral column were coordinated. The study shows that Feng's Spinal Manipulation has excellent therapeutic effect in the treatment of sequestrated lumbar disc herniation.

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Disclosure of conflict of interest

None.

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References

[1] Fardon DF, Milette PC. Nomenclature and classification of lumbar disc pathology. Recommendations of the Combined task Forces of the North American Spine Society, American Society of Spine Radiology, and American Society of Neuroradiology. Spine 2001; 26: E93-113.

[2] Daghighi MH, Pouriesa M, Maleki M, Fouladi DF, Pezeshki MZ, Mazaheri Khameneh R, Bazzazi AM. Migration patterns of herniated disc fragments: a study on 1,020 patients with extruded lumbar disc herniation. Spine J 2014; 14: 1970-7.

[3] Feng TY. Treatment of Soft tissue injury with traditional Chinese and western medicine. 1st edition. Beijing People's medical Publish House; 1977. pp. 28-30.

[4] Feng TY. Clinical study on Soft tissue injury with traditional Chinese and western medicine. China Scientific Technologic Publish House 2002; 15: 28-30

[5] Pao H, Ding YS, Zhou L. Application in computer tomography of herniated lumber intervertebral disc. J Pract Radiol 1998; 14: 411-2.

[6] Kikkawa I, Sugimoto H, Saital K, Ookami H, Nakama S, Hoshino Y. The role of Gd-enhanced three-dimensional MRI fast low-angle shot (FLASH) in the evaluation of symptomatic lumbosacral nerve roots. J Orthop Sci 2001; 6: 101-9.

[7] Toyone T, Takahashi K, Kitahara H, Yamagata M, Murakami M, Moriya H. Visualisation of symptomatic nerve roots.Prospective study of contrast-enhanced MRI in patients with lumbar disc herniation. J Bone Joint Surg Br 1993; 75: 529-33.

[8] Mixter WJ, Barr JS. Rupture of the intervertebral disc with involvement of the spinal canal. N Engl J Med 1934; 211: 210

[9] Jiang H. MRI of bones and joints. 2nd Edition. Shanghai: Shang Hai Science and Technology Publishing House; 2011. pp. 40.

[10] Macki M, Hernandez-Hermann M, Bydon M, Gokaslan A, McGovern K, Bydon A. Spontaneous regression of sequestrated lumbar disc herniations: Literature review. Clin Neurol Neurosur 2014; 120: 136-41.

[11] Sengoz A, Kotil K, Tasdemiroglu E. Posterior epidural migration of herniated lumbar disc fragment. J Neurosurg Spine 2011; 14: 313-7.

[12] Akhaddar A, El-Asri A, Boucetta M. Posterior epidural migration of a lumbar disc fragment: a series of 6 cases. J Neurosurg Spine 2011; 15: 117-28.

[13] Kim JS, Lee SH, Arbatti NJ. Dorsal extradural lumbar disc herniation causing caudaequina syndrome: a case report and review of literature. J Korean Neurosurg Soc 2010; 47: 217-20.

[14] Cui WF, Hao CJ, Gong WC. Surgical treatment of sequestered lumbar disc herniation. Orthop 2013; 4: 45-46.

[15] Xu BS, Xia Q, Ji N. Endoscopic surgery with mobile endospine system for the sequestered lumbar disc herniation. Chin J Orthop 2011; 31: 431-5.