Retrospective Clinical Research Report

Journal of INTERNATIONAL MEDICAL RESEARCH

Journal of International Medical Research
49(4) 1–13

DOI: 10.1177/03000605211004520
journals.sagepub.com/home/imr
SAGE

Prognosis of C4 dislocation with spinal cord injury following psychological intervention

Min-Chao Zhao[1], Kai Yang[1], Bao-Hui Yang[1], Shuai Guo[1], Ya-Ping Wang[2], Xiao-Wei Zhang[3] and Hao-Peng Li[1]

Abstract

Objective: To investigate the effect of psychological intervention on the prognosis of patients with C4 dislocation and spinal cord injury.

Methods: We investigated target patients admitted between 2010 and 2018. Patients' mental state, quality of life and neurological function at different time points were evaluated to examine the relationship between psychological intervention and recovery and prognosis of acute and critical spinal cord injury.

Results: All patients showed improvements in clinical symptoms, neurological function and quality of life. Psychological intervention significantly improved Zung Self-Rating Anxiety Scale score, Zung Self-Rating Depression Scale score and SF-36 Mental Component Summary score within 3 months. Japanese Orthopaedic Association neurological function score and SF-36 Physical Component Summary score were significantly improved after 1-year follow-up. Psychological intervention did not improve 2-year survival.

Conclusion: Timely and professional psychological intervention can eliminate the psychological disorders of C4 dislocation patients with spinal cord injury. This has a positive effect on their quality of life and prognosis.

[1]Department of Orthopaedics, Second Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China
[2]Department of Psychology and Psychiatry, Second Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China
[3]Department of Orthopaedics, First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China

Corresponding author:
Hao-Peng Li, Department of Orthopaedics, Second Affiliated Hospital of Xi'an Jiaotong University, 157th West Fifth Road, Xi'an, Shaanxi Province 710004, China.
Email: lhp-3993@163.com

Keywords
C4 dislocation, psychological intervention, cervical spinal cord injury, anxiety, depression, prognosis, life quality

Date received: 18 January 2021; accepted: 3 March 2021

Introduction

The position of the C4 vertebra is unique: it belongs anatomically to the lower cervical spine (C3–C7), but is linked to the corresponding upper cervical spinal cord (C1–C4). There are few survivors of C1–C3 spinal cord injury, but individuals may survive C4 spinal cord injury if treated in time. Spinal cord injury below C4 (C5–C8) is generally not life threatening, but patients often show upper extremity segmental sensory and motor dysfunction after injury. There are few large-sample studies on patients with C4 spinal cord injury.

C4 dislocation with spinal cord injury is a serious trauma with high mortality.[1–4] Patients experience quadriplegia and a series of complications, such as respiratory, nervous, cardiovascular and urinary system problems,[5–8] which considerably reduces quality of life, often causes substantial mental stress and leads to psychological disorders such as anxiety and depression. In modern clinical medicine,[9,10] psychological factors play an important role in the development and prognosis of disease. There have been many studies on the role of psychological factors in cancer, endocrine disorders, cardiovascular disorders and other diseases,[11–14] but there are no reports in the spinal cord injury literature on the relationship between psychological intervention and prognosis in patients with C4 dislocation.

Owing to medical resource limitations, heavy economic burden of patients and outdated treatment concepts, patients with cervical spinal cord injury in China are often treated in spine surgery centres after hospital admission, and go home directly after discharge. During hospitalization, any psychological counselling the patient receives is generally provided by their family and friends rather than by a professional psychiatrist. Against this background of cervical spinal cord injury treatment in China, this study evaluated the effects of professional psychological intervention on postinjury anxiety, depression, neurological function, quality of life and survival in patients with C4 dislocation and spinal cord injury. The study emphasizes the importance of surgeons actively introducing a professional psychotherapy team to facilitate prognosis to supplement surgical treatment. It also discusses the current status and future needs of traditional spinal surgery modalities in China.

Materials and methods

Patients

With written approval from the medical ethics committee of Second Affiliated Hospital of Xi'an Jiaotong University (approval no. 2020048), we collected data on all target patients with neck injuries between 2010 and 2018. This was a retrospective case control study. All procedures were carried out in accordance with the code of ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

Written informed consent was obtained from the patients. After admission, patients were offered psychological evaluation in addition to general symptomatic treatment. The inclusion criteria were 1) C4 dislocation without C4 vertebral fracture or other segmental injury; 2) no disability before the injury, with normal motor and sensory functions of limbs; 3) no recent history of neck surgery before the injury; 4) received surgical treatment. Exclusion criteria were 1) mental or nervous system diseases; 2) other serious injuries or dysfunction of heart, lung, brain or other important organs; 3) inability to cooperate with follow-up; 4) mild C4 dislocation without neurological symptoms.

Clinical outcome measures

The Zung Self-Rating Anxiety Scale (SAS) and the Zung Self-Rating Depression Scale (SDS) were used to assess anxiety and depression.[15–19] Each questionnaire contains 20 items, with a total score of 20 to 80. The scales have demonstrated good reliability and can effectively assess the overall anxiety and depression status of patients. Scores lower than 50 on the SAS indicate normal psychological status, 50 to 59 indicates mild anxiety, 60 to 69 moderate anxiety, and 70 or more severe anxiety. SDS score ranges from 20 to 80 ('no depression' to 'major depression'). Scores greater than 49 indicate substantial depression. American Spinal Injury Association (ASIA) spinal cord injury classification and the Japanese Orthopaedic Association (JOA) score were used to assess neurological function. The Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) was used to assess patient quality of life, and comprises a Physical Component Summary (PCS) measure and a Mental Component Summary (MCS) measure.[20] High scores on the SF-36 indicate better quality of life. Responses to all scale items were evaluated and analysed before surgery, 3 months after surgery, 6 months after surgery, 1 year after surgery and 2 years after surgery. After discharge, the patients were regularly visited and evaluated by a professional team according to each time point.

Groups

Participants were randomly divided into two groups according to the minimum imbalance index method. To protect patients' privacy, all study participants were anonymous. The control group received conventional systemic treatment at the Spine Surgery Centre, including but not limited to general symptomatic treatment, surgical treatment, routine postoperative nursing, routine postoperative neurological exercise, postoperative respiratory exercise and the company of family members or nursing workers.[21] In addition to routine treatment, the intervention group simultaneously received (free of charge) professional psychotherapy by psychiatrists.

Psychological interventions

All psychological interventions occurred during the period of hospitalization after injury. In addition to conventional surgical treatment, a professional psychological treatment team provided a psychological treatment intervention during hospitalization. The treatment comprised three aspects: cognitive–behavioural psychotherapy, supportive psychotherapy, and medication.[22–25] Cognitive–behavioural psychotherapy included the use of systematic desensitization to promptly manage patients' denial, fear and anxiety and to help patients and family members to gradually accept the disease and actively cooperate with treatment and rehabilitation. Supportive psychotherapy included

companionship, listening, encouragement and communication between patients. Medication included appropriate use of anxiolytic and antidepressant drugs.

Surgical approaches

Two main surgical approaches were used: the anterior approach and the combined anterior and posterior approach. After admission, all patients received closed reduction using cervical traction. If the interlocking of the articular process disappeared after traction, the anterior approach was used. Otherwise, the combined anterior and posterior approach was selected. All surgical procedures were performed by an experienced team at the Spine Surgery Centre and were selected based on each patient's injury and physical condition. Regardless of which surgical method was used, the ultimate goal of surgery was to achieve stable internal fixation and sufficient spinal cord decompression.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). Parameters were analysed as the mean (standard deviation, SD) and compared using two-sided Student t-tests or the χ^2. The significance level was set at $P < 0.05$.

Results

Of 108 patients with C4 dislocation and spinal cord injury screened, 24 declined the psychological assessment. After psychological evaluation of the remaining individuals, patients who met either of the anxiety or depression criteria were considered to have mental disorders. After excluding 12 people, 72 were included in the study (Figure 1), with 36 in the control group and 36 in the intervention group. There were 88 men and 20 women, aged 17 to 79 years (average of 47.21 ± 14.03 years). Of these, 89 patients were of Han ethnicity and 19 were of Hui.

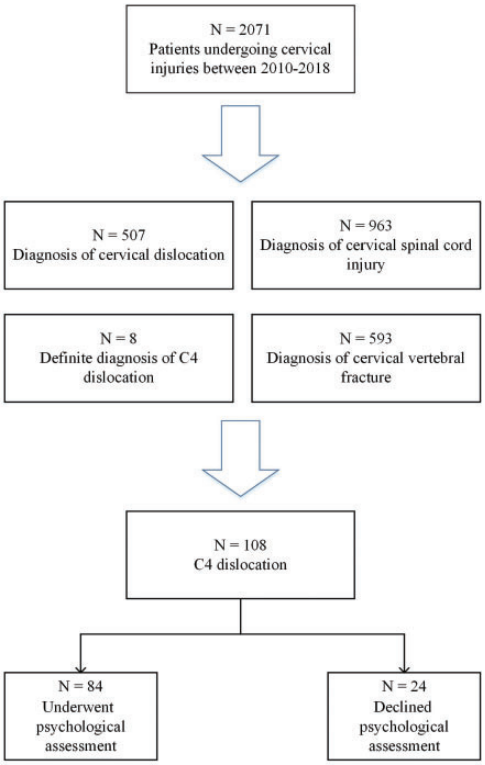

Figure 1. Patient selection.

Regarding cause of injury, 58 people had been injured in traffic accidents, 32 injured by falling, 10 injured by heavy objects and 8 injured by falling from high places. There were 28 patients with rib fractures and 25 patients with limb fractures. The anterior approach was used for 56 patients and the combined anterior and posterior approach for 16 patients (Figure 2). Background characteristics of the two groups, such as age, sex, preoperative JOA score, preoperative SAS score, preoperative SDS score, preoperative SF-36 PCS score and preoperative SF-36 MCS score, were independently tested using the t-test ($P > 0.05$) to ensure compliance with the principle of equilibrium (Table 1).

At the beginning of the study; that is, before surgery, the JOA score, SAS score, SDS score and SF-36 score (including PCS and MCS scores) were not significantly different between the intervention and control groups (Table 2).

Neurological function in the two groups continued to improve after receiving surgery until 2 years after surgery (Figure 3; Table 2). There were no significant differences in JOA scores between the intervention group and the control group at 3 months and 6 months. At 1 year post-surgery, the JOA scores of the two groups began to differ ($P = 0.043$). At 2 years post-surgery, the JOA scores were still significantly different between the two groups ($P = 0.042$), 8.55 ± 3.82 in the control group and 10.76 ± 3.27 in the intervention group. Changes in ASIA spinal cord injury classification are shown in Table 3.

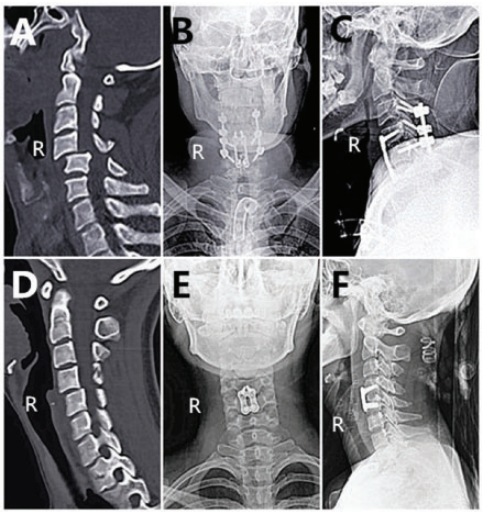

Figure 2. Surgical approaches. Preoperative radiographs [(A) sagittal; (D) sagittal]. Postoperative radiographs of two surgical approaches: combined anterior and posterior approach [(B) coronal; (C) sagittal] and anterior approach [(E) coronal; (F) sagittal]. Informed consent was obtained from the patient.

Regarding patient mental health, the SAS and SDS scores of both groups declined (Figure 4; Table 2). There were significant differences in the SAS and SDS scores between the intervention group and the control group at 3 months ($P < 0.01$; $P < 0.01$), 6 months ($P < 0.01$; $P < 0.01$), 1 year ($P < 0.01$; $P < 0.01$), and 2 years ($P < 0.01$; $P < 0.01$) post-surgery.

Regarding quality of life, the PCS and MCS scores of the control group and the intervention group at 2 years post-surgery were significantly higher than before surgery (Figure 5; Table 2). There were no significant differences in PCS scores between the two groups at 3 months and 6 months. PCS scores of the intervention group were significantly different from those of the control group at 1 year ($P < 0.01$) and 2 years ($P < 0.01$). MCS scores of the

Table 1. Demographic data.

Characteristic	Control (N = 36)	Intervention (N = 36)	*P* value
Age (years), mean ± SD	45.03 ± 14.04	49.39 ± 13.88	0.189
Sex, male/female, n	29/7	26/10	0.405
Preoperative JOA score, mean ± SD	6.19 ± 2.03	6.11 ± 1.69	0.850
Preoperative SAS score, mean ± SD	59.53 ± 4.40	59.36 ± 3.62	0.861
Preoperative SDS score, mean ± SD	62.75 ± 5.14	60.83 ± 4.09	0.084
Preoperative SF-36 PCS score, mean ± SD	34.00 ± 12.38	30.68 ± 12.52	0.261
Preoperative SF-36 MCS score, mean ± SD	57.29 ± 17.13	60.51 ± 18.16	0.442

JOA, Japanese Orthopaedic Association; SAS, Zung Self-Rating Anxiety Scale; SDS, Zung Self-Rating Depression Scale; SF-36, MOS 36-Item Short Form Health Survey; PCS, Physical Component Summary; MCS, Mental Component Summary; SD, standard deviation.

Table 2. Changes in clinical outcomes during postoperative follow-up.

Time point	Group	N	JOA	SAS	SDS	SF-36	
						PCS	MCS
Presurgery	Control	36	6.19 ± 2.03	59.53 ± 4.40	62.75 ± 5.14	34.00 ± 12.38	57.29 ± 17.13
	Intervention	36	6.11 ± 1.69	59.36 ± 3.62	60.83 ± 4.09	30.68 ± 12.52	60.51 ± 18.16
3 months	Control	29	6.31 ± 1.85	59.66 ± 3.5	58.17 ± 2.25	41.73 ± 12.94	47 ± 23.16
	Intervention	32	6.59 ± 1.68	54.59 ± 2.7*	54.03 ± 1.89*	42.64 ± 10.02	74.09 ± 14.85*
6 months	Control	24	6.5 ± 1.79	58.17 ± 2.78	57.54 ± 1.84	44.59 ± 8.99	46.07 ± 16.1
	Intervention	29	7.03 ± 1.92	51.03 ± 3.17*	51.86 ± 3.51*	46.3 ± 10.78	68.78 ± 15.23*
1 year	Control	20	6.9 ± 2.05	53.2 ± 2.38	52.9 ± 2.15	46.85 ± 11.46	57.23 ± 12.83
	Intervention	26	8.35 ± 2.53*	45.77 ± 2.89*	46.31 ± 3.89*	57.51 ± 7.21*	76.22 ± 9.02*
2 years	Control	20	8.55 ± 3.82	45.7 ± 2.41	49.05 ± 2.58	53.78 ± 10.62	66.91 ± 14.09
	Intervention	25	10.76 ± 3.27*	35.36 ± 3.21*	37.16 ± 2.9*	65.73 ± 9.15*	75.44 ± 9.28*

The JOA, SAS, SDS, PCS and MCS scores are all reported as mean ± standard deviation.
JOA, Japanese Orthopaedic Association; SAS, Zung Self-Rating Anxiety Scale; SDS, Zung Self-Rating Depression Scale; SF-36, MOS 36-Item Short Form Health Survey; PCS, Physical Component Summary; MCS, Mental Component Summary.
*Statistically significant difference between the control and intervention groups.

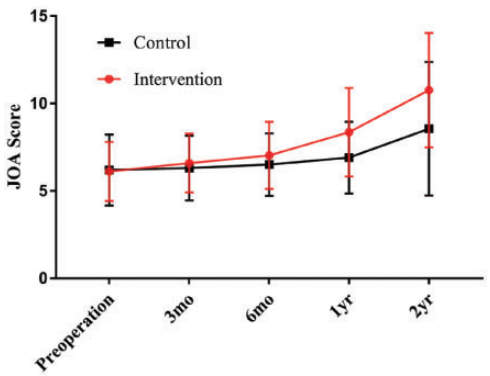

Figure 3. Improvements in JOA scores (mean [SD]) at different postoperative time points. JOA, Japanese Orthopaedic Association; SD, standard deviation.

intervention group and the control group were significantly different at 3 months ($P < 0.01$), 6 months ($P < 0.01$), 1 year ($P < 0.01$), and 2 years ($P = 0.026$) post-surgery.

It is worth noting that during the study, patients in both the control and intervention groups died successively (Figure 6). By 2 years post-surgery, 20 patients in the control group and 25 patients in the intervention group had survived. However, psychological intervention did not significantly affect the 2-year survival in the two groups (Table 4).

The causes of death can be approximately classified into respiratory diseases, cardiovascular diseases, urinary system diseases, cerebrovascular diseases and others. Most patients died of respiratory diseases, particularly respiratory failure (Table 5). All the deceased patients had received systematic specialized treatment or rescue in the hospital before they died.

Discussion

For patients with cervical spinal cord injury, the surgeon's first consideration during the admission is the traumatic condition and stability of vital signs. This is appropriate and understandable from the perspective of treatment.[26] However, when the patient is stable after receiving specialized surgical treatment, doctors usually shift their attention to other severely injured patients. In the process, the psychological

Table 3. ASIA spinal cord injury classification during follow-up.

Time point	Group	N	ASIA				
			A	B	C	D	E
Pre-surgery	Control	36	8	20	8	0	0
	Intervention	36	7	23	6	0	0
3 months	Control	29	5	16	8	0	0
	Intervention	32	5	18	9	0	0
6 months	Control	24	5	11	8	0	0
	Intervention	29	4	15	10	0	0
1 year	Control	20	3	8	8	1	0
	Intervention	26	2	14	7	3	0
2 years	Control	20	2	5	7	4	2
	Intervention	25	1	5	8	7	4

ASIA, American Spinal Injury Association.

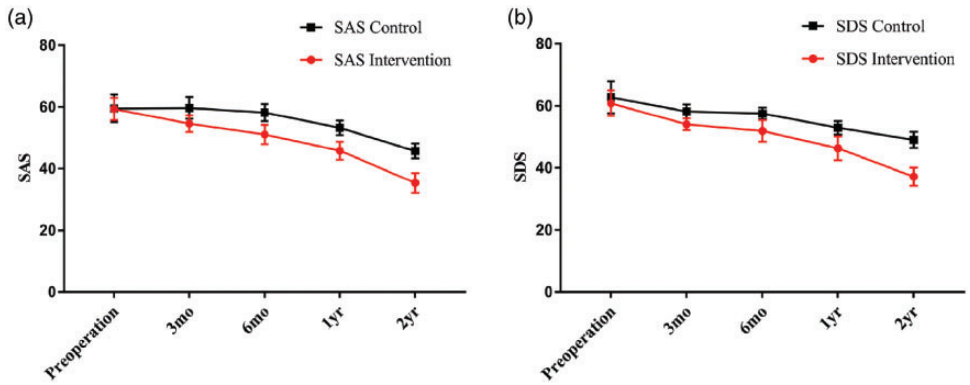

Figure 4. Improvements in SAS (a) and SDS (b) scores (mean [SD]) at different postoperative time points. SAS, Zung Self-Rating Anxiety Scale; SDS, Zung Self-Rating Depression Scale; SD, standard deviation.

changes of injured patients tend to be quietly ignored. This situation is common in many large teaching hospitals in China. Surgeons pay more attention to whether the surgical procedure itself is perfect, and the technical achievements it reflects.[27] An important question is whether this treatment approach, which is commonplace and widely implemented, is necessarily sufficient. Good operative techniques can certainly promote the recovery of patients' injuries, but (just like the logarithmic growth curve) current mainstream surgical techniques carried out by teams with similar technical skill levels are limited. There are many factors that play an important role in recovery.[28] How to further promote the recovery of patients and improve their quality of life is an issue that needs urgent attention. There is an old saying in China: 'Only when you are in a good mood can you be healthy'. Is this really the case?

Modern medicine has shifted from a purely biomedical model to a biopsychosocial medical model.[29] A growing number of clinical disciplines have realized the

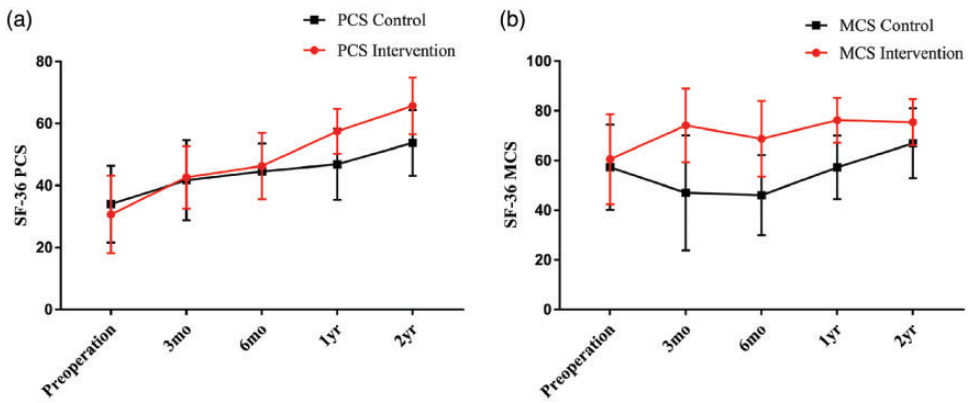

Figure 5. Improvements in SF-36 scores (mean [SD]) at different postoperative time points. SF-36, Short Form Health Survey; PCS, Physical Component Summary; MCS, Mental Component Summary; SD, standard deviation.

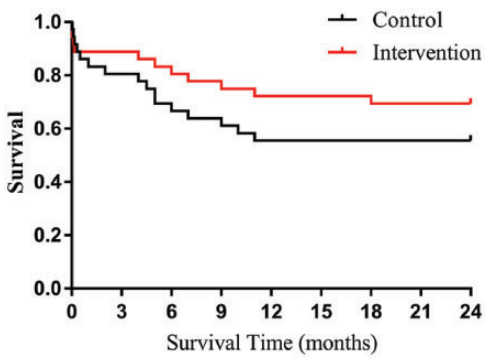

Figure 6. Survival curves of patients during the postoperative follow-up period.

importance of psychological factors in disease outcomes,[11] especially the disciplines of endocrinology, oncology and cardiology.[12–14] The use of psychotherapy to improve prognosis and patient quality of life is receiving increasing attention.[30] Clinicians, especially surgeons, should pay more attention to the overall psychological, physical and social fitness of patients to ensure their safety and quality of life.[31] However, few surgeons in China consider psychotherapy indispensable to the treatment process.

Previous research has demonstrated the important role that emotions play in health.[32] Surveys show that more than 70% of people worldwide have experienced traumatic events to varying degrees, and 31% of these individuals experience four or more traumatic events.[33] Cervical spinal cord injury caused by C4 dislocation is a serious trauma. In addition to physical function damage, it can often cause anxiety, depression and even posttraumatic stress disorder (PTSD).[34] The core symptoms of PTSD are traumatic memory invasion, avoidance of trauma-related stimuli, negative cognitive and emotional changes, enhanced arousal and excessive behaviour after one or more traumas.[35] More than 50% of patients have mood, anxiety and substance abuse disorders, and some also show aggression and self-harm behaviour.[36] Preliminary findings suggest that connections between portions of the anterior cingulate cortex contribute to the persistence of negative emotions and are important in identifying the possible brain mechanism underlying persistent sadness in daily life.[37]

This study focused on the effect of professional psychological interventions on the recovery of neurological function, mental

Table 4. Two-year survival.

Group	Survival	Death	Total	Survival rate (%)
Control	20	16	36	55.56%
Intervention	25	11	36	69.44%
Total	45	27	72	62.50%

$\chi^2 = 1.481$, $P = 0.224$.

Table 5. Causes of death during follow-up.

Cause of death	Control	Intervention
Respiratory failure	5	4
Pulmonary infection	3	4
Pulmonary embolism	1	1
Myocardial infarction	1	0
Heart failure	1	1
Urinary tract infection	1	0
Renal failure	1	1
Cerebral haemorrhage	1	0
Cerebral infarction	1	0
Others	1	0

health, quality of life and survival prognosis at various time points after injury. Novel approaches such as the use of psychological interventions can supplement traditional treatment methods, which are still widely used in China. Previous studies have confirmed the positive physical and mental effects of psychological interventions.[38]

Regarding neural function recovery, the JOA scores of the two groups of patients did not differ until 1 year post-surgery ($P = 0.043$), which demonstrates that neural function takes a long time to recover.[39] Previous studies have shown that the neurological function recovery rate in patients with cervical spinal cord injury is positively correlated with follow-up time. Neurological improvement at 6 months or less is not as obvious as that at long-term follow-up of 3 to 5 years.[40] This study confirms this pattern to some extent. At 2 years post-surgery, the intervention group and the control group both improved, but the gap between them widened further. This supports previous findings of the positive effect of psychological intervention on spinal cord injury.[41]

In terms of mental health, this study mainly evaluated the two most common psychological disorders after major traumas, anxiety and depression, using the SAS and the SDS. Anxiety and depression scores in the control group were still higher at 6 months post-surgery compared with before surgery. It was not until 1 year post-surgery that SAS and SDS scores in the control group declined significantly ($P < 0.01$). In the intervention group, SAS and SDS scores declined from 3 months to 2 years post-surgery, and were always significantly different from those of the control group ($P < 0.01$). This indicates that it took time for patients' psychological state to change under normal conditions.[42] SAS and SDS scores in the control group began to decline only approximately 1 year

post-surgery. However, psychological interventions can have positive and substantial effects in a very short period.[43] In contrast, neurological function improves slowly in the early stages after surgery.[39,40]

The quality-of-life results showed that PCS scores did not differ significantly between the two groups until 1 year post-surgery, (similar to the neurological function recovery shown by JOA scores). This suggests that physical recovery requires time.[44,45] Psychological intervention cannot rapidly change objective neurological damage; rather, its effect is more long-term. The between-group difference in postoperative MCS scores indicated that the psychological intervention had a rapid and strong effect on patients' mental health, a pattern similar to the changes in SAS and SDS scores.

In terms of prognosis, there was no significant between-group difference in the 2-year survival rate, which might reflect the limited follow-up time and the lack of longer-term results. It has been reported that 42.8% of cervical spinal cord injury deaths occur within 1 week, 68.3% within 2 weeks and 90.5% within 4 weeks.[46] Regarding cause of death, 27 people died within 2 years in this study; 16 died from respiratory diseases (9 from respiratory failure and 7 from pulmonary infection). This suggests that the prevention and treatment of respiratory complications is essential. Previous studies show that respiratory dysfunction and pulmonary complications are the main causes of short-term and long-term mortality in patients with cervical spinal cord injury;[2,3] the present findings are consistent with this. This suggests that for patients with cervical spinal cord injury, respiratory tract management is very important and can improve patient survival rate and quality of life.[2,47]

This study only explored the effects on long-term clinical prognosis of professional psychological intervention for patients with C4 dislocation with spinal cord injury. The findings were positive. Individuals who experience major trauma such as cervical spinal cord injury often develop PTSD owing to sudden changes in their living conditions, career and interpersonal relationships after the injury. Positive, effective and timely professional psychological intervention can help to prevent the development of negative emotions, so that patients can rebuild their confidence and hope in life, reshape social relationships, and more actively cooperate with treatment and rehabilitation. This type of intervention requires the joint input of molecular biology, endocrinology, neurophysiology, psychophysiology, humanities, sociology and other approaches.

There were several study limitations, such as a relatively small sample and the retrospective design. Moreover, we did not track the subsequent recovery of patients who did not have psychological disorders or declined psychological assessment at admission, and could not compare the prognosis of these patients with those with psychological disorders. Considering the particularity of C4 spinal cord injury, it is unlikely that these patients will maintain a good psychological state. At the time of admission assessment, most patients did have psychological disorders. We suspect that psychological disorders are universal in patients with C4 dislocation and spinal cord injury, and this study confirms the positive effect of psychological intervention for these individuals.

Conclusions

For patients with C4 dislocation and spinal cord injury, timely professional psychological intervention after injury substantially improves their mental health, long-term recovery of neurological function and quality of life. Surgeons should actively cooperate with psychiatrists, pay attention to the

role of psychological intervention in disease prognosis and consider psychotherapy an essential standard treatment.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ORCID iD

Hao-Peng Li https://orcid.org/0000-0002-2162-6358

References

1. Allen BJ Jr, Ferguson RL, Lehmann TR, et al. A mechanistic classification of closed, indirect fractures and dislocations of the lower cervical spine. *Spine (Phila Pa 1976)* 1982; 7: 1–27. DOI: 10.1097/00007632-198200710-00001.
2. Hagen EM, Lie SA, Rekand T, et al. Mortality after traumatic spinal cord injury: 50 years of follow-up. *J Neurol Neurosurg Psychiatry* 2010; 81: 368–373. DOI: 10.1136/jnnp.2009.178798.
3. Hagen EM. Acute complications of spinal cord injuries. *World J Orthop* 2015; 6: 17–23. DOI: 10.5312/wjo.v6.i1.17.
4. Oh YM and Eun JP. Cardiovascular dysfunction due to sympathetic hypoactivity after complete cervical spinal cord injury: a case report and literature review. *Medicine (Baltimore)* 2015; 94: e686. DOI: 10.1097/MD.0000000000000686.
5. Mneimneh F, Moussalem C, Ghaddar N, et al. Influence of cervical spinal cord injury on thermoregulatory and cardiovascular responses in the human body: literature review. *J Clin Neurosci* 2019; 69: 7–14. DOI: 10.1016/j.jocn.2019.08.022.
6. Lemons VR and Wagner FJ. Respiratory complications after cervical spinal cord injury. *Spine (Phila Pa 1976)* 1994; 19: 2315–2320. DOI: 10.1097/00007632-199410150-00011.
7. Hou S and Rabchevsky AG. Autonomic consequences of spinal cord injury. *Compr Physiol* 2014; 4: 1419–1453. DOI: 10.1002/cphy.c130045.
8. Rodriguez-Romero V, Guizar-Sahagun G, Castaneda-Hernandez G, et al. Early systemic alterations in severe spinal cord injury: an experimental study on the impact of injury level on renal function. *Spine (Phila Pa 1976)* 2018; 43: E885–E890. DOI: 10.1097/BRS.0000000000002578.
9. Bokhari AR, Sivakumar B, Sefton A, et al. Morbidity and mortality in cervical spine injuries in the elderly. *Anz J Surg* 2019; 89: 412–417. DOI: 10.1111/ans.14875.
10. Rivers CS, Fallah N, Noonan VK, et al. Health conditions: effect on function, health-related quality of life, and life satisfaction after traumatic spinal cord injury. A prospective observational registry cohort study. *Arch Phys Med Rehabil* 2018; 99: 443–451. DOI: 10.1016/j.apmr.2017.06.012.
11. Cassel EJ. The nature of suffering and the goals of medicine. *N Engl J Med* 1982; 306: 639–645. DOI: 10.1056/NEJM198203183061104.
12. Hunter CM. Understanding diabetes and the role of psychology in its prevention and treatment. *Am Psychol* 2016; 71: 515–525. DOI: 10.1037/a0040344.
13. Jimenez-Fonseca P, Lorenzo-Seva U, Ferrando PJ, et al. The mediating role of spirituality (meaning, peace, faith) between psychological distress and mental adjustment in cancer patients. *Support Care Cancer* 2018; 26: 1411–1418. DOI: 10.1007/s00520-017-3969-0.
14. Chauvet-Gelinier JC, Bonin B. Stress, anxiety and depression in heart disease patients: a major challenge for cardiac rehabilitation. *Ann Phys Rehabil Med* 2017; 60: 6–12. DOI 10.1016/j.rehab.2016.09.002.
15. Zung WW. A rating instrument for anxiety disorders. *Psychosomatics* 1971; 12: 371–379. DOI: 10.1016/S0033-3182(71)71479-0.
16. Zung WW. A self-rating depression scale. *Arch Gen Psychiatry* 1965; 12: 63–70. DOI: 10.1001/archpsyc.1965.01720310065008.

17. Zung WW and Wonnacott TH. Treatment prediction in depression using a self-rating scale. *Biol Psychiatry* 1970; 2: 321–329.
18. Zung WW, Richards CB and Short MJ. Self-rating depression scale in an outpatient clinic. Further validation of the SDS. *Arch Gen Psychiatry* 1965; 13: 508–515. DOI: 10.1001/archpsyc.1965.01730060026004.
19. Zung WW. The depression status inventory: an adjunct to the self-rating depression scale. *J Clin Psychol* 1972; 28: 539–543. DOI: 10.1002/1097-4679(197210)28: 4<539: : aid-jclp2270280427>3.0.co; 2-s.
20. Ware JJ and Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992; 30: 473–483.
21. Grant RA, Quon JL and Abbed KM. Management of acute traumatic spinal cord injury. *Curr Treat Options Neurol* 2015; 17: 334. DOI: 10.1007/s11940-014-0334-1.
22. Roberts NP, Kitchiner NJ, Kenardy J, et al. Early psychological intervention following recent trauma: a systematic review and meta-analysis. *Eur J Psychotraumatol* 2019; 10: 1695486. DOI: 10.1080/20008198.2019.1695486.
23. Borza L. Cognitive-behavioral therapy for generalized anxiety. *Dialogues Clin Neurosci* 2017; 19: 203–208.
24. Freyberger H and Freyberger HJ. Supportive psychotherapy. *Psychother Psychosom* 1994; 61: 132–142. DOI: 10.1159/000288881.
25. Rosenblat JD, Kurdyak P, Cosci F, et al. Depression in the medically ill. *Aust N Z J Psychiatry* 2019: 4867419888576. DOI: 10.1177/0004867419888576.
26. Markandaya M, Stein DM and Menaker J. Acute treatment options for spinal cord injury. *Curr Treat Options Neurol* 2012; 14: 175–187. DOI: 10.1007/s11940-011-0162-5.
27. Dearani JA, Gold M, Leibovich BC, et al. The role of imaging, deliberate practice, structure, and improvisation in approaching surgical perfection. *J Thorac Cardiovasc Surg* 2017; 154: 1329–1336. DOI: 10.1016/j.jtcvs.2017.04.045.
28. Naredi P and La Quaglia MP. The future of trials in surgical oncology. *Nat Rev Clin Oncol* 2015; 12: 425–431. DOI: 10.1038/nrclinonc.2015.72.
29. Engel GL. The need for a new medical model: a challenge for biomedicine. *Science* 1977; 196: 129–136. DOI: 10.1126/science.847460.
30. Expósito-Vizcaíno S, Sánchez-Rodríguez E and Miró J. The role of physical, cognitive and social factors in pain interference with activities of daily living among individuals with chronic cancer pain. *Eur J Cancer Care (Engl)* 2019: e13203. DOI: 10.1111/ecc.13203.
31. Aftab A, Lee EE, Klaus F, et al. Meaning in life and its relationship with physical, mental, and cognitive functioning: a study of 1,042 community-dwelling adults across the lifespan. *J Clin Psychiatry* 2019; 81: pii: 19m13064. DOI: 10.4088/JCP.19m13064.
32. O'Bryan EM, McLeish AC and Johnson AL. The role of emotion reactivity in health anxiety. *Behav Modif* 2017; 41: 829–845. DOI: 10.1177/0145445517719398.
33. Benjet C, Bromet E, Karam EG, et al. The epidemiology of traumatic event exposure worldwide: results from the World Mental Health Survey Consortium. *Psychol Med* 2016; 46: 327–343. DOI: 10.1017/S0033291715001981.
34. Hatch R, Young D, Barber V, et al. Anxiety, depression and post traumatic stress disorder after critical illness: a UK-wide prospective cohort study. *Crit Care* 2018; 22: 310. DOI: 10.1186/s13054-018-2223-6.
35. Qi W, Gevonden M and Shalev A. Prevention of post-traumatic stress disorder after trauma: current evidence and future directions. *Curr Psychiatry Rep* 2016; 18: 20. DOI: 10.1007/s11920-015-0655-0.
36. Pietrzak RH, Goldstein RB, Southwick SM, et al. Prevalence and Axis I comorbidity of full and partial posttraumatic stress disorder in the United States: results from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. *J Anxiety Disord* 2011; 25: 456–465. DOI: 10.1016/j.janxdis.2010.11.010.
37. Schwartz J, Ordaz SJ, Kircanski K, et al. Resting-state functional connectivity and inflexibility of daily emotions in major

depression. *J Affect Disord* 2019; 249: 26–34. DOI: 10.1016/j.jad.2019.01.040.
38. Silva Guerrero AV, Maujean A, Campbell L, et al. A systematic review and meta-analysis of the effectiveness of psychological interventions delivered by physiotherapists on pain, disability and psychological outcomes in musculoskeletal pain conditions. *Clin J Pain* 2018; 34: 838–857. DOI: 10.1097/AJP.0000000000000601.
39. Badhiwala JH, Ahuja CS and Fehlings MG. Time is spine: a review of translational advances in spinal cord injury. *J Neurosurg Spine* 2018; 30: 1–18. DOI: 10.3171/2018.9.SPINE18682.
40. Khorasanizadeh M, Yousefifard M, Eskian M, et al. Neurological recovery following traumatic spinal cord injury: a systematic review and meta-analysis. *J Neurosurg Spine* 2019; 30: 683–699. DOI: 10.3171/2018.10.SPINE18802.
41. Craig A, Hancock K, Chang E, et al. The effectiveness of group psychological intervention in enhancing perceptions of control following spinal cord injury. *Aust N Z J Psychiatry* 1998; 32: 112–118. DOI: 10.3109/00048679809062717.
42. Haun MW, Estel S, Rucker G, et al. Early palliative care for adults with advanced cancer. *Cochrane Database Syst Rev* 2017; 6: CD011129. DOI: 10.1002/14651858.CD011129.pub2.
43. Zimmermann T, Puschmann E, Van Den Bussche H, et al. Collaborative nurse-led self-management support for primary care patients with anxiety, depressive or somatic symptoms: cluster-randomised controlled trial (findings of the SMADS study). *Int J Nurs Stud* 2016; 63: 101–111. DOI: 10.1016/j.ijnurstu.2016.08.007.
44. Babcock ZR, Kogut SJ and Vyas A. Association between polypharmacy and health-related quality of life among cancer survivors in the United States. *J Cancer Surviv* 2020; 14: 89–99. DOI: 10.1007/s11764-019-00837-y.
45. Hagell P, Westergren A and Arestedt K. Beware of the origin of numbers: standard scoring of the SF-12 and SF-36 summary measures distorts measurement and score interpretations. *Res Nurs Health* 2017; 40: 378–386. DOI: 10.1002/nur.21806.
46. Zhu W, Jia LS, Shao J, et al. Time of early death after cervical spinal cord injury. *Zhonghua Yi Xue Za Zhi* 2007; 87: 2342–2345. DOI: 10.3760/j.issn: 0376-2491.2007.33.011.
47. Kopp MA, Watzlawick R, Martus P, et al. Long-term functional outcome in patients with acquired infections after acute spinal cord injury. *Neurology* 2017; 88: 892–900. DOI: 10.1212/WNL.0000000000003652.