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Effect of the duration of chronic low back pain on pain sensitivity of patients undergoing lumbar fusion surgery

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Abstract. *Background: chronic low back pain is a serious social problem. In recent years, patients who choose lumbar fusion surgery due to chronic low back pain has been increasing. Pre-existing chronic pain has been associated with severe postoperative pain. In this study, we have sought to prospectively analyze the association between the duration of chronic low back pain and pain sensitivity after lumbar fusion surgery.*

Methods: *400 patients who underwent lumbar fusion surgery were divided into three groups based on the duration of chronic pain. During the first postoperative day, the maximum pain scores of each patient day and night, the pain scores at the day of discharge, the consumption of postoperative analgesics and the length of hospital stay were recorded.*

Results: *of 400 patients recruited, 369 patients completed the experiment. There was no significant difference in gender, age, height, weight, pre-operative pain at rest, and operation time in the three groups. During the day, the pain sensitivity of the three groups were 1.71 ± 0.66 , 2.40 ± 0.74 , 2.90 ± 0.80 . During the night, the pain sensitivity of the three groups were 3.45 ± 0.81 , 4.31 ± 1.06 , 4.86 ± 1.05 . At the day of discharge, the pain sensitivity of three groups were 1.26 ± 0.46 , 1.47 ± 0.58 , 1.96 ± 0.64 . There were significant differences in pain sensitivity among the three groups during the day and night on the first postoperative day and at the day of discharge ($p < 0.05$). The length of hospital stay (7.31 ± 1.36 days, 8.82 ± 1.48 days, 9.60 ± 1.61 days) and analgesic consumption (25.04 ± 36.56 mg, 33.52 ± 24.04 mg, 45.15 ± 24.89 mg, morphine equivalent) were also significant differences ($p < 0.05$).*

Conclusion: *we found the duration of chronic low back pain before lumbar fusion surgery affects patient' postoperative pain sensitivity, consumption of analgesic drugs and hospital stay. The longer the preoperative chronic pain lasts, the higher the postoperative VAS score is, the more analgesic drugs were consumed, and the longer hospital stay is.*

Key words: *effect, duration of chronic low back pain, pain sensitivity, lumbar fusion surgery*

1. Introduction

Low back pain is one of the most frequent reasons for people to seek medical services [1, 2]. It will not only cause a high disability rate but also increase people's medical burden [3]. Some people can recover through natural recovery or some form of intervention, and some people become chronic low back pain. Chronic low back pain is generally considered to be persistent low back pain for more than three months [4]. The most commonly proposed causes of chronic low back pain are lumbar degenerative diseases, including lumbar spine stenosis, lumbar spondylolisthesis, disc herniation and degenerative disc disease [5]. At the same time, these lumbar degenerative diseases are also the most common reasons for patients to choose fusion and internal fixation surgery [6, 7].

In the past two decades, the number of patients choosing lumbar fusion surgery due to lumbar degenerative diseases has been increasing worldwide [8]. Clinical experience pointed out that most patients chose fusion surgery to enable them to continue to work and to live an active life [9]. However, in spine surgery patients at high risk of postoperative pain [10]. Optimizing postoperative pain management can facilitate surgical recovery [11]. Recognizing the risk factors of acute or persistent pain after lumbar fusion surgery can be targeted for perioperative treatment, including tailored postoperative pain treatment or individualized postoperative follow-up. At present, factors for affecting postoperative pain sensitivity of patients can be broadly grouped into gender [12], obesity [13], preoperative opioid abuse [14], genetics [15], and many other factors. Preoperative chronic pain also affects postoperative pain sensitivity and postoperative patient functional recovery [16–18]. However, there is no report on the study of the duration of chronic pain before surgery and the sensitivity of patients after surgery. A careful review of the relevant literature did not find any report about the effect of the duration of chronic low back pain on the pain sensitivity of patients undergoing lumbar fusion surgery.

We conducted a prospective, single-center study. Our primary purpose is to evaluate effect of different chronic low back pain duration on postoperative pain sensitivity of patients undergoing lumbar fusion surgery. Our secondary purpose is to evaluate the consumption of analgesics and the difference in hospital stay. Provide a certain reference for the pain management of patients with chronic low back pain surgery.

2. Materials and Methods

2.1. Study design and setting

This study has been registered at the Chinese Clinical Trial Registration Center (<http://www.chictr.org.cn/>

[index.aspx](#)) under the number (ChiCTR2000029923) and was approved by the Chinese Registered Clinical Trial Ethics Review Committee approval number (Chi-ECRCT20200165). The trial was conducted at The First Affiliated Hospital of USTC. Written informed consents were obtained from all participating patients.

2.2. Subjects

From 1 May 2020 to 31 October 2020, we selected 400 patients with ASA grades I to III, who had chronic low back pain before surgery, and planned to undergo two-level open lumbar fusion surgery under general anesthesia. Exclusion criteria:

1. Cognitive impairment (unable to provide informed consent).
2. Refusal to participate.
3. Take analgesic drugs before surgery or have a history of opioid abuse.
4. Chronic opioid or gabapentin treatment.
5. Patients with other chronic pain conditions (not related to surgical indications).
6. Low back pain manifested by one or more specific causes (for example, cancer, fractures and infections).
7. They have previously undergone lumbar spine surgery.
8. Acute exacerbation of chronic low back pain.

The duration of chronic low back pain of the recruited patients ranged from three months to ten years. According to their pain duration, Chronic low back pain patients can be classified into three groups: the duration of pain was less than one year, one to five years, more than five years. The visual analogue scale (VAS) was used to evaluate the pain intensity (maximum intensity) during the day and night of the patient on the first postoperative day after surgery and at the day of discharge, with a score ranging from 0 (no pain) to 10 (unimaginable pain). All patients were treated with postoperative intravenous self-controlled analgesia. Analgesic pump formula: Sufentanil 100 μ g, analgesic pump parameters: background infusion dose 2 ml/h. If the VAS score is greater than four points, use analgesics for remedy. When patients reported pain greater than 4 on a 0–10 visual analog scale (VAS), oral oxycodone (10 mg q 8 h) was utilized. An intramuscular injection of parecoxib (40 mg) was used if a patient claimed severe pain greater than 6 on the VAS. The patient's analgesic dosage (calculated in morphine equivalent, analgesics for remedy) and length of hospital stay were recorded. The pain assessment was done independently by three raters: the first postoperative day was assessed by the nurse during the day and the doctor during the night. Pain scores at the day of discharge was assessed by another doctor. The raters were not clear about the assessment of others' scores.

2.3. Statistical analysis

Statistical calculations were performed using IBM SPSS Statistics Version 22. Mean with standard deviations were used, Data are shown as mean \pm standard deviation (SD), number (%). Prior to the parametric tests, all data were evaluated for homogeneity of variances using Levene's test, three groups of data are compared by one-way analysis of variance, multiple comparisons between groups were performed by Student–Newman–Keuls test. and an alpha significance level of $p < 0.05$ was accepted.

3. Results

This study finally included 369 patients (Fig. 1). The comparison of the three groups of patients is shown in Table 1. There were similar percentages of men and women in three groups. Patients in three groups were of similar age, height and weight. There was no statistical difference in pre-operative pain at rest and operation time. The pri-

mary result of this experiment was the pain score (maximum) during the day and night on the first postoperative day and at the day of discharge, the secondary result was the consumption of analgesics (measured in mg of morphine equivalents, analgesics for remedy) and length of hospital stay.

Primary outcome

In all the patients, the intensity of pain ranged from 1 to 7 both at day and at night. Pain score of the third group was significantly more intense than other groups, both shortly after surgery and at the time of discharge home (Table 2). During the day, the pain sensitivity of the three groups were 1.71 ± 0.66 , 2.40 ± 0.74 , 2.90 ± 0.80 . During the day, the pain sensitivity of the three groups were 3.45 ± 0.81 , 4.31 ± 1.06 , 4.86 ± 1.05 . At the day of discharge, the pain sensitivity of three groups were 1.26 ± 0.46 , 1.47 ± 0.58 , 1.96 ± 0.64 . There are significant differences in pain sensitivity among the three groups during the day and night

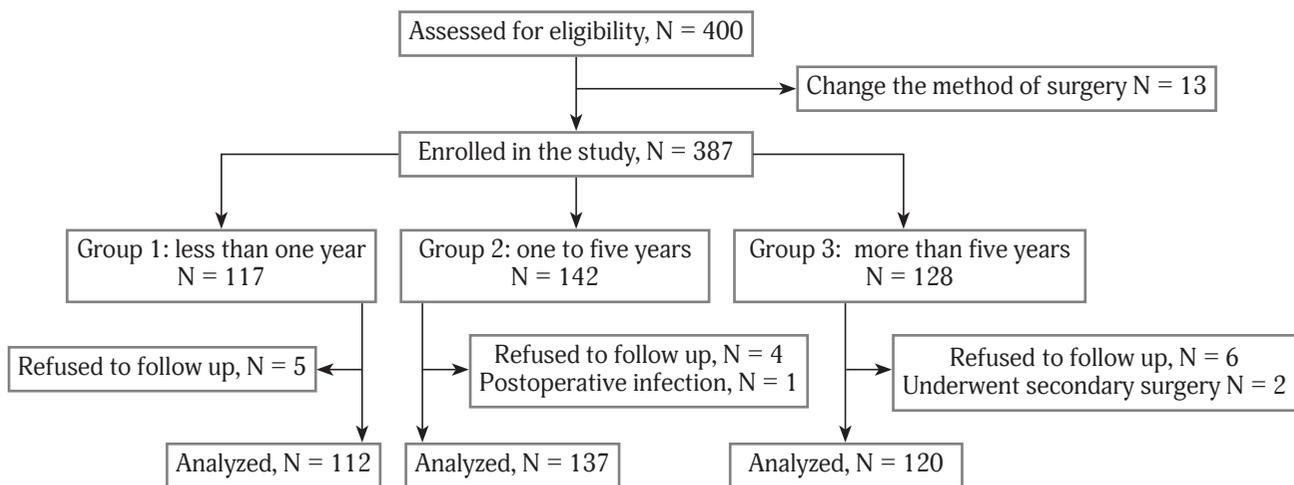


Fig. 1. Schematic illustration of the study design and the patient-selection

Table 1. The comparison of three groups of patients who underwent lumbar fusion surgery

	Group 1 (N=112)	Group 2 (N=137)	Group 3 (N=120)	p
Women (%)	68 (60.71 %)	80 (58.39 %)	75 (62.50 %)	ns
Men (%)	44 (39.29 %)	57 (41.61 %)	45 (37.50 %)	ns
Age (years)	54.15 \pm 10.26	54.70 \pm 9.92	56.06 \pm 8.69	ns
Height (cm)	164.05 \pm 7.46	163.95 \pm 8.16	162.21 \pm 6.95	ns
Weight (kg)	66.02 \pm 10.39	65.12 \pm 10.68	63.60 \pm 10.56	ns
Operation time (min)	120.80 \pm 8.56	122.68 \pm 9.08	123.48 \pm 10.67	ns
Pre-operative pain (at rest)	1.54 \pm 0.50	1.49 \pm 0.50	1.50 \pm 0.50	ns

ns, not statistically significant

Table 2. Primary outcome: intensity of pain in three groups on the first postoperative day and at the day of discharge

	Group 1 (N=112)	Group 2 (N=137)	Group 3 (N=120)	p
VAS (night)	3.45 ± 0.81	4.31 ± 1.06	4.86 ± 1.05	p < 0.05
VAS (day)	1.71 ± 0.66	2.40 ± 0.74	2.90 ± 0.80	p < 0.05
VAS (discharge)	1.26 ± 0.46	1.47 ± 0.58	1.96 ± 0.64	p < 0.05

and at the day of discharge. The longer the chronic pain lasts, the higher the pain sensitivity.

Secondary outcome

The patients' hospital stay ranged from 4 to 16 days. Three groups hospital stay were 7.31 ± 1.36 days, 8.82 ± 1.48 days, 9.60 ± 1.61 days, analgesic consumption (morphine equivalent, analgesics for remedy) of three groups were 25.04 ± 36.56 mg, 33.52 ± 24.04 mg, 45.15 ± 24.89 mg (Table 3). There are significant differences in hospital stay and analgesic consumption among the three groups.

4. Discussion

The purpose of this study is to examine whether the duration of chronic low back pain before lumbar fusion surgery affects patient' postoperative pain sensitivity, consumption of analgesic drugs and hospital stay. The results of our study indicate that it is related.

Postoperative pain is the main factor affecting the functional recovery of patients after surgery [19, 20]. At present, people's focus is more on the prevention and treatment of postoperative acute pain [21], often neglecting the impact of preoperative chronic pain on postoperative pain and functional recovery. Chronic pain before surgery will cause a series of problems for patients after surgery. Study have found that preoperative chronic pain distracted people's attention before surgery, and reduced the recovery of attention and memory abilities during the follow-up period after the surgery in non-elderly patients [22]. People have begun to pay attention to the impact of chronic pain before surgery on postoperative recovery. A prospective study of chronic pain on postoperative pain and functional recovery of patients undergoing hip replacement surgery found that patients with chronic pain other than hip-related pain were associated with slower postoperative mobilization, poorer physical func-

tion, and greater psychological distress after surgery [23]. Regarding pain sensitivity, studies have pointed out that patients with chronic low back pain before surgery show increased sensitivity to pain and decreased sensitivity to harmless stimuli [24], and patients with a history of low back pain have decreased pain tolerance [25]. In a study of the correlation between chronic pain and pain sensitivity, Joachim Erlenwein and his colleagues [17] found that patients with chronic pain had higher intensity of zoster-related acute pain. However, there is no relevant research on whether the duration of chronic pain affects pain sensitivity and consumption of analgesic drugs. This study found that the longer the duration of chronic low back pain, the more increased sensitivity to pain after surgery, the more consumption of analgesics drugs and the length of hospital stay in patients after lumbar fusion.

Intervertebral disc degeneration is considered to be the main cause of chronic low back pain [26]. The degenerated intervertebral disc contains high levels of pro-inflammatory mediators and cytokines [27, 28]. Secondary osteoarthritis with or without synovial facets is the main source of cLBP pain. Long-term inflammation can lead to chronic pain. At the same time, these inflammatory mediators can also reduce the pain threshold of patients [29]. We believe that the impact of chronic pain duration on the pain sensitivity of lumbar fusion surgery may be related to the duration of chronic inflammation. In a trial [13] that studied obesity and postoperative pain sensitivity, it was found that obese patients had higher pain sensitivity, which may be related to macrophages. Cell accumulation is related to the release of inflammatory mediators. Obese patients have more macrophages than non-obese patients, which may help reduce the pain threshold of obese patients [30]. Chronic inflammation is a long-term accumulation process. The longer the duration of chronic pain, the higher the pain sensitivity of lumbar fusion surgery,

Table 3. Secondary outcome: length of stay in hospital and analgesic consumption in three groups

	Group 1 (N=112)	Group 2 (N=137)	Group 3 (N=120)	p
Hospital stay (days)	7.31 ± 1.36	8.82 ± 1.48	9.60 ± 1.61	p < 0.05
Analgesic consumption (mg)	25.04 ± 36.56	33.52 ± 24.04	45.15 ± 24.89	p < 0.05

which may be related to the release of more inflammatory mediators in these patients.

Another reason may be that the duration of chronic pain is related to the different mental and psychological effects of patients. The current chronic pain is classified according to the pain time, and the patient's functional limitations and emotional symptoms should also be considered. The dimensional score cannot fully conform to the multifactorial nature of pain [31, 32]. In addition, chronic pain is often accompanied by psychosocial complications [33]. Preoperative anxiety levels, neuropathic pain, and chronic pre-operative pain intensity were association with the efficacy of pain management after knee surgery [34]. These factors may have a significant impact on the perception of pain. For example, chronic pain combined with anxiety, preoperative anxiety and acute postoperative pain are significantly correlated. The more severe preoperative anxiety, The greater the need for analgesia [35]. Chronic pain can lead to the development and aggravation of anxiety disorders, whereas anxiety disorders can lead to increased pain duration and intensity [36]. This shows that chronic pain will have a series of effects on the patient's spirit and psychology. The longer the chronic pain lasts, the more likely the patient will have symptoms such as anxiety. It has been reported that the preoperative mentality, mental state, and preoperative disaster score will affect the postoperative recovery [37–39]. Regarding whether there is a difference in the disaster score of patients with different chronic pain durations, we will continue to study in the next step.

The limitation of this article is that the patients' education level, previous physiotherapy and adverse lifestyle are not taken into account. It has reported that factors such as smoking, obesity, psychological distress, depressive mood increased risk of chronicity [40]. Adverse lifestyles such as nicotine use may affect postoperative recovery [36]. Among cases requiring thoracoscopic radical lung cancer surgery, highly nicotine-dependent patients who are deprived of cigarettes before surgery require a larger quantity of postoperative sufentanil and experience more severe pain than nonsmokers, preoperative smoking cessation as early as possible may contribute to postoperative pain relief in this patient population [41]. Researchers pointed out that patients who smoke may be engaged in stressful jobs, education, weak social support systems, and poor self-care activities [42].

5. Conclusion

For patients with a history of chronic low back pain who undergo lumbar fusion surgery, the longer the preoperative pain lasts, the higher the postoperative VAS score, the more analgesic drugs were consumed, and the longer

the hospital stay. This result indicates that the longer the duration of chronic pain before surgery, the higher the postoperative pain sensitivity of patients. Therefore, it is very important to pay attention to patients' chronic pain before surgery, especially the duration of chronic pain. Patients with long-lasting chronic pain should undergo stricter analgesia treatment supervision after surgery to prevent patients from suffering more severe pain.

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Вплив тривалості хронічного болю в попереку на больову чутливість пацієнтів, які переносять хірургічну операцію поперекового зрощення

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Анотація. Передумови: хронічний біль у попереку є серйозною соціальною проблемою. Останніми роками збільшується кількість пацієнтів, які обирають операцію поперекового зрощення через хронічні болі в попереку. Раніше існуючий хронічний біль був пов'язаний із сильним післяопераційним болем. У цьому дослідженні ми намагалися проаналізувати зв'язок між тривалістю хронічного болю в попереку та больовою чутливістю після хірургічної операції поперекового зрощення.

Методи: 400 пацієнтів, які перенесли хірургічну операцію поперекового зрощення, були розділені на три групи залежно від тривалості хронічного болю. Протягом першого післяопераційного дня реєструвались максимальні показники болю кожного пацієнта вдень і вночі, показники болю в день виписки, споживання післяопераційних анальгетиків і тривалість перебування в лікарні.

Результати: із 400 відібраних пацієнтів експеримент завершили 369 пацієнтів. У трьох групах не було значної різниці у статі, віці, зрості, вазі, передопераційному болі в стані спокою та тривалості операції. Протягом доби больова чутливість трьох груп становила $1,71 \pm 0,66$, $2,40 \pm 0,74$, $2,90 \pm 0,80$ відповідно. Протягом ночі больова чутливість трьох груп становила $3,45 \pm 0,81$, $4,31 \pm 1,06$, $4,86 \pm 1,05$ відповідно. У день виписки больова чутливість трьох груп становила $1,26 \pm 0,46$, $1,47 \pm 0,58$, $1,96 \pm 0,64$ відповідно. Були значні відмінності в больовій чутливості серед трьох груп протягом дня і ночі в перший післяопераційний день і в день виписки ($p < 0,05$). Тривалість перебування в лікарні ($7,31 \pm 1,36$ дня, $8,82 \pm 1,48$ дня, $9,60 \pm 1,61$ дня) та споживання знеболювальних препаратів ($25,04 \pm 36,56$ мг, $33,52 \pm 24,04$ мг, $45,15 \pm 24,89$ мг, еквівалент морфію) також мали суттєві відмінності ($p < 0,05$).

Висновок: ми виявили, що тривалість хронічного болю в попереку перед хірургічною операцією поперекового зрощення впливає на післяопераційну больову чутливість пацієнта, споживання знеболювальних препаратів та перебування в лікарні. Чим довше триває передопераційний хронічний біль, тим вищий післяопераційний показник VAS, тим більше споживаних знеболювальних препаратів і довший термін перебування в лікарні.

Ключові слова: ефект, тривалість хронічного болю в попереку, больова чутливість, операція поперекового зрощення

Влияние продолжительности хронической боли в поясничном отделе на болевую чувствительность пациентов, перенесших хирургическую операцию поясничного сращения

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Аннотация. Предпосылки: хроническая боль в пояснице является серьезной социальной проблемой. В последние годы увеличивается количество пациентов, которые выбирают операцию поясничного сращения из-за хронических болей в пояснице. Ранее существовавшая хроническая боль была связана с сильной послеоперационной болью. В этом исследовании мы пытались проанализировать связь между продолжительностью хронической боли в пояснице и болевой чувствительностью после хирургической операции поясничного сращения.

Методы: 400 пациентов, перенесших хирургическую операцию поясничного сращения, были разделены на три группы в зависимости от продолжительности хронической боли. В течение первого послеоперационного дня регистрировались максимальные показатели боли каждого пациента днем и ночью, показатели боли в день выписки, потребление послеоперационных анальгетиков и продолжительность пребывания в больнице.

Результаты: из 400 отобранных пациентов эксперимент завершили 369 пациентов. В трех группах не было значительной разницы в поле, возрасте, росте, весе, предоперационной боли в состоянии покоя и продолжительности операции. В течение суток болевая чувствительность трех групп составляла $1,71 \pm 0,66$, $2,40 \pm 0,74$, $2,90 \pm 0,80$ соответственно. В течение ночи болевая чувствительность трех групп составляла $3,45 \pm 0,81$, $4,31 \pm 1,06$, $4,86 \pm 1,05$ соответственно. В день выписки болевая чувствительность трех групп составляла $1,26 \pm 0,46$, $1,47 \pm 0,58$, $1,96 \pm 0,64$ соответственно. Были значительные различия в болевой чувствительности среди трех групп в течение дня и ночи в первый послеоперационный день и в день выписки ($p < 0,05$). Продолжительность пребывания в больнице ($7,31 \pm 1,36$ дня, $8,82 \pm 1,48$ дня, $9,60 \pm 1,61$ дня) и потребления обезболивающих препаратов ($25,04 \pm 36,56$ мг, $33,52 \pm 24,04$ мг, $45,15 \pm 24,89$ мг, эквивалент морфия) также имели существенные различия ($p < 0,05$).

Вывод: мы обнаружили, что продолжительность хронической боли в пояснице перед хирургической операцией поясничного сращения влияет на послеоперационную болевую чувствительность пациента, потребление обезболивающих препаратов и пребывание в больнице. Чем дольше длится предоперационная хроническая боль, тем выше послеоперационный показатель VAS, тем больше потребляемых обезболивающих препаратов и дольше срок пребывания в больнице.

Ключевые слова: эффект, продолжительность хронической боли в пояснице, болевая чувствительность, операция поясничного сращения