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Evaluating Day Surgery for Pain Interventions: A Retrospective Analysis of Three Common Conditions

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Research Article

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Evaluating Day Surgery for Pain Interventions: A Retrospective Analysis of Three Common Conditions

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Abstract

Background: Traditional inpatient procedure (TIP) typically requires several days of hospitalization, contributing to bed shortages and rising healthcare costs. Day surgery procedure (DSP) may offer comparable clinical outcomes with greater efficiency, but evidence across multiple pain conditions remains limited. Frozen shoulder (FS), trigeminal neuralgia (TN), and osteoporotic vertebral compression fractures (OVCF) are common chronic pain conditions and represent minimally invasive pain procedures with potential for day-surgery pathways.

Methods: This retrospective study included inpatients diagnosed with FS, TN, or OVCF between January 2023 and July 2025 at Nanjing Drum Tower Hospital. Patients were divided into the day surgery group (DSG, planned discharged within 24 hours) and the traditional inpatient group (TIG). Inverse probability of treatment weighting (IPTW) was used to balance baseline characteristics. Outcomes included Visual Analog Scale (VAS) pain scores at baseline, 1, 7, 30, and 90 days, complication rates, hospital stays, direct

medical costs, and patient satisfaction. Generalized estimating equations (GEE) were applied for repeated VAS measures.

Results: A total of 277 DSG and 653 TIG patients were analyzed. After IPTW, all baseline covariates were well balanced (standardized mean differences < 0.1). The GEE model showed no significant difference in overall VAS scores between groups, with a significant time effect and no significant group-by-time interaction. Complication rates were comparable between groups. The DSG demonstrated significant cost reductions in patients with FS (¥6643.2 vs. ¥7633.55, p<0.001), TN (¥5188.52 vs. ¥6068.33, p<0.001), and OVCF (¥7827.72 vs. ¥9297.95, p<0.001). The mean duration of hospital stays was significantly shorter for the DSG across three cohorts: FS (1.90 vs. 2.43 days, p=0.028), TN (1.61 vs. 2.98 days, p<0.001), and OVCF (1.86 vs. 3.53 days, p<0.001). Patient satisfaction was higher in the DSG (p < 0.05). Among patients planned for day surgery, 90.3% were successfully discharged within 24 hours.

Conclusion: For these three common pain conditions, day surgery achieved short-term pain relief and safety comparable to TIP, while significantly reducing hospital stay and costs. These findings support that the DSP is worthy of widespread application in pain medicine.

Key words: day surgery, pain management procedures, frozen shoulder, trigeminal neuralgia, osteoporotic vertebral compression fractures

Introduction

Chronic pain has become a major challenge in global public health, not only seriously affecting the quality of life of patients, but also imposing a heavy burden on the global social economy[1]. The traditional inpatient procedure (TIP) typically requires patients to stay in

the hospital for 3 to 7 days, particularly for older adults. Prolonged hospitalization increases healthcare costs, contributes to bed shortages, imposes a significant economic and medical burden on both patients and society[2]. Moreover, hospitalization itself carries multiple risks, including hospital-acquired infections and thromboembolic events, which can hinder patients' rehabilitation progress[3]. Therefore, there is an urgent need for more efficient and optimized surgical treatment procedures.

Over the past two decades, day surgery has experienced rapid growth driven by patient demand and healthcare economic reform. This model refers to a treatment process where patient admission, surgery, and discharge are all completed within 24 hours [4]. Day surgery procedure (DSP) has been shown to optimize surgical procedures and minimize costs in other fields [5, 6], and it is now clinically feasible to extend this approach to pain medicine. In response to the Chinese healthcare policies, our department has implemented the day surgery model for several years. Frozen shoulder (FS), trigeminal neuralgia (TN) and osteoporotic vertebral compression fractures (OVCF) stand out among chronic pain conditions due to their high prevalence, severe pain, and significant functional impairment [7-9]. For patients unresponsive to conservative treatment, interventional therapies such as radiofrequency ablation (RFA) and percutaneous vertebroplasty (PVP) have been proven effective in alleviating symptoms[10-12]. These three conditions are commonly managed with minimally invasive pain procedures, and are highly suitable for the day surgery model[13].

To our knowledge, most existing studies on day surgery focus on a single condition[14, 15]. This is the first multi-condition retrospective analysis comparing day surgery with traditional

inpatient treatment for pain interventions in China. We retrospectively compared patients receiving DSP and TIP across three common diseases (FS, TN and OVCF) by evaluating clinical efficacy and safety to provide evidence supporting the expanded application of day surgery in pain medicine.

Patients and Methods

Patients

The study complied with the principles outlined in the Declaration of Helsinki and was approved by the Medical Ethics Committee of Nanjing Drum Tower Hospital (No. 2025-0604-01). The data were collected and analyzed retrospectively from the medical records of inpatients diagnosed with FS, TN or OVCF between January 2023 and July 2025 in the Pain Department at Nanjing Drum Tower Hospital. FS patients underwent an intra-articular injection of corticosteroids, a manipulation under anaesthesia (MUA), and suprascapular nerve (SSN) and axillary nerve (AN) pulsed radiofrequency (PRF). TN patients received a semilunar ganglion RFA, and OVCF patients received PVP therapy. The subjects were divided into two groups, the day surgery group (DSG) and the traditional inpatient group (TIG), according to the different clinical admission procedures.

The inclusion criteria were as follows: Patients diagnosed with primary FS (unilateral frozen shoulder, frozen stage), TN (primary TN, refractory to medical treatment) or OVCF (osteoporosis-related, single thoracic/lumbar segment) based on clinical symptoms, signs and imaging examinations; Age > 18 years old; Visual Analogue Scale (VAS) scores ≥4; American Society of Anesthesiologists (ASA) classification < Grade Ⅲ. The exclusion criteria were as follows: Incomplete perioperative or follow-up clinical data; Severe

bleeding disorders, coagulation dysfunction or infection in the surgical area; FS patients with a history of shoulder fracture or rotator cuff injury; OVCF patients with spinal stenosis, incomplete vertebral posterior wall, or nerve injury symptoms.

Pre-Operative Preparation

The decision regarding the mode of treatment, whether day surgery or traditional inpatient procedure, was primarily determined by the specialists and patients. The TIG patients were admitted to hospital in the usual way, underwent preoperative examinations and evaluations, surgeries, and postoperative recovery. The DSG patients completed preoperative examinations in the outpatient department. The examinations included but not limited to: a routine blood test, a metabolic panel, a coagulation function and an electrocardiogram. Based on the results, physicians determined whether patients were eligible for day surgery.

Surgery and Post-Operative Management

All surgical procedures were conducted under standard continuous monitoring and strict sterile technique.

The surgical procedure for patients with FS was as follows. After brachial plexus anesthesia on the affected side had fully taken effect, the shoulder joint was manipulated using the method described by Kraal T et al.[16]. This involves manually releasing the attached shoulder joint capsule to effectively and quickly improve range of motion. Then, patients received an ultrasound-guided intra-articular injection of the glenohumeral joint (drug mixture: 1 ml of compound betamethasone injection; 2 ml of 2% lidocaine; and 7 ml of saline)[17]. At last, PRF of the SSN and AN was performed. A 20-gauge radiofrequency

needle with a 10-mm flexible tip and 10-cm length was precisely positioned under ultrasound guidance at the SSN and AN (Figure 1). Adjust the position of the needle tip according to the sensory stimulation (50 Hz, 1 ms pulse width, 0.3-0.5 V; patients reported shoulder paresthesia) and motor stimulation (2 Hz, 1 ms pulse width, 1-2 V; patients experienced twitches in the suprascapular, infrascapular and deltoid muscles). Two PRF cycles of 180 s (2 Hz, 20 ms pulse width, 100 V, 42 °C) were performed. All patients were instructed to perform home rehabilitation exercises three times a day for 15 minutes each time, in order to improve shoulder joint mobility. These exercises included pendulum exercises, wall-climbing exercises, passive external-rotation stretches and internal-rotation stretches.

The semilunar ganglion RFA operation process was as follows. The TN patients were placed supine on the CT scanning table with a cushion under their neck. After local anesthesia with1% lidocaine, the 20-gauge 10 mm active tip puncture needle was inserted from 2.5 to 3 cm lateral to the affected side of the mouth into the foramen ovale according to the Hartel landmark approach[10]. Adjust the position of the needle tip until it successfully entered Meckel's cave (Figure 2). Sensory stimulation was then used to induce paresthesia in the distribution area of the trigeminal nerve, and motor stimulation was used to induce masticatory movement. Then thermal radiofrequency was performed at 70–80°C with a treatment time of 300 seconds.

The PVP operation process was as follows. The OVCF patients were placed prone on the CT scanning table. An unenhanced thin-layer CT scan was used to position and mark the body surface. After local anesthesia with 1% lidocaine, the puncture needle was inserted

into the anterior middle third of the fractured vertebral body and bone cement was injected. Diffusion of the bone cement within the vertebral body was then monitored under CT scan (Figure 3). After the bone cement had completely solidified, the puncture needle was withdrawn, and the incision was stitched and bandaged. Patients were allowed to get out of bed wearing a rigid brace six hours postoperatively. All patients received standardized anti-osteoporosis drug treatment and were instructed in back muscle strengthening exercises.

Discharge criteria included stable vital signs, VAS ≤3, no active bleeding, and no need for further treatment for surgical complications. DSG patients were planned for discharge within 24 hours and an overnight stay was permitted if necessary. Those failing to meet discharge criteria would have delayed discharge but still be retained in the DSG for analysis.

Data Collection

The following data were collected for all patients: (1) baseline characteristics including gender, age, body mass index (BMI), comorbiditiies, pathological site information, insurance type, and baseline VAS; (2) VAS at 1, 7, 30, and 90 days postoperatively; (3) postoperative complication; (4) the duration of hospital stays and total hospital costs; (5) patient satisfaction scored on a 10-point scale; and (6) reasons for delayed discharge in the DSG.

Statistical Analysis

All statistical analyses were performed using R version 4.5.0. Continuous variables were presented as mean ± standard deviation (SD), and categorical variables as frequencies (percentages).

To control for potential confounding, inverse probability of treatment weighting (IPTW) was applied to balance baseline characteristics. Propensity scores were estimated using a multivariable logistic regression model, with surgical model (DSP vs. TIP) as the dependent variable and age, sex, insurance type, disease duration, BMI, comorbidities, pathological site information, and baseline VAS as covariates. Stabilized IPTW weights were calculated, and weights exceeding the 1st and 99th percentiles were truncated to minimize the influence of extreme values. Balance was assessed using standardized mean differences (SMD), with SMD <0.1 considered well-balanced.

Repeated VAS measurements were analyzed using generalized estimating equations (GEE), with an exchangeable correlation structure and IPTW weights incorporated. Comparisons between groups were made using independent samples t-test or Mann-Whitney U test for continuous variables, and chi-square test or Fisher's exact test for categorical variables, as appropriate. A two-sided p-value < 0.05 was considered statistically significant.

Results

Demographics and Clinical Characteristics

A total of 143 patients with FS were finally enrolled, including 62 in the DSG and 81 in the TIG. Baseline characteristics before and after IPTW are shown in Table 1, and all covariates were well-balanced. 79.0% (49/62) of the patients in the DSG were successfully discharged within 24 hours. The most common reasons for delayed discharge included completing MRI examinations, poor pain control, and social factors.

304 TN patients were included in the analysis, 89 in the DSG and 215 in the TIG. Baseline

characteristics before and after IPTW are shown in Table 2. Before weighting, there were some differences between groups in comorbidities such as diabetes and heart disease. After IPTW, all covariates were well-balanced, with standardized mean differences <0.1 for all variables. 3.4% (3/89) of the patients in the DSG failed to be discharged on time, due to poor pain control (VAS > 3) and the need for a secondary operation.

Among OVCF patients (DSG n=126, TIG n=357), the groups were comparable in baseline characteristics (Table 3). Among patients planned for day surgery, 91.3% (115/126) were successfully discharged on time. The most common reasons for delayed discharge were completing osteoporosis-related examinations and postoperative soft tissue pain.

Clinical Efficacy and Complications

The VAS scores at each time point after surgery in both the DSG and TIG were significantly lower than the baseline (sFigure 1-3). Among FS, TN and OVCF patients, the GEE model revealed no significant difference in overall VAS scores between the DSG and TIG ($p > 0.05$). There was a significant time effect ($p < 0.05$), indicating that pain improved over time in both groups. The group-by-time interaction was not significant ($p > 0.05$), showing parallel pain trajectories between the two groups.

Complication rates were similar between the DSG and TIG patients (Table 4). All TN patients experienced facial numbness after the surgery, and in addition, masseter weakness occurred in 82% of TIG and 78.1% of DSG ($p = 0.473$)，facial swelling in 16.8% vs 14.5% ($p = 0.613$), and nausea and vomiting in 4.4% vs 7.0% ($p = 0.365$). For OVCF patients, cement leakage occurred in 28.0% vs 27.5% ($p = 0.925$). Most patients experienced cement leakage were asymptomatic and required no further treatment. No

major adverse events (such as infection, bleeding, pneumothorax, tendon rupture, joint dislocation or fracture) were reported for the FS patients.

Resource Utilization and Satisfaction

In all cohorts, day surgery was associated with lower average total hospital costs and shorter hospital stays(Table 5). The DSG demonstrated significant cost reductions in patients with FS (¥6643.2 vs. ¥7633.55, p<0.001), TN (¥5188.52 vs. ¥6068.33, p<0.001), and OVCF (¥7827.72 vs. ¥9297.95, p<0.001). The mean duration of hospital stays was significantly shorter for the DSG across three cohorts: FS (1.90 vs. 2.43 days, p=0.028), TN (1.61 vs. 2.98 days, p<0.001), and OVCF (1.86 vs. 3.53 days, p<0.001). Patient satisfaction scores were higher in the DSG, FS (9.40 vs. 9.1, p=0.043), TN (9.54 vs. 9.18, p<0.001), and OVCF (9.51 vs. 9.28, p<0.001).

Discussion

The retrospective cohort study assessed differences between patients who underwent day-surgery and those who received traditional inpatient treatment for FS, TN and OVCF. Using IPTW and GEE, we found that DSP is comparable to TIP in terms of pain relief and complication rates, but resulted in significantly shorter hospital stays and lower direct medical costs. Patient satisfaction was also higher in the day surgery group. Importantly, the analysis included patients with delayed discharge in the DSG, our findings provide a more realistic assessment of the feasibility of day surgery in clinical practice.

The primary finding of this study is that day surgery demonstrates as effective as traditional inpatient surgery in relieving pain through 90 days long-term follow-up. There exists a common clinical concern about postoperative recoveries regarding the day surgery model,

worrying that early discharge may compromise pain management. However, the GEE analysis showed no significant difference between groups at any time point, and the parallel trajectories indicate that the rate of improvement was similar regardless of discharge timing. This conclusion is consistent with findings from previous relevant studies. Nie et al. found that day surgery vertebroplasty demonstrated comparable efficacy and safety to traditional inpatient treatment for OVCF over a 12-month follow-up period[15]. After the follow-up of 380 patients, Xu et al. suggested that spiral CT-guided balloon compression day surgery to treat TN is safe, effective, and worthy of clinical promotion[14]. In addition to efficiency, complications are also an important criterion to consider while evaluating day surgery. No serious adverse reactions or complications were observed in FS patients during the surgical procedures or follow-up period. In FS patients, manipulation of the shoulder joint under anesthesia and PRF may cause pneumothorax, tendon rupture, joint dislocation or fracture and so on, but standard ultrasound-guided procedures make these complications extremely rare[18]. In TN patients, RFA is a neurodestructive treatment and will inevitably results in a high incidence of postoperative facial numbness and masseter weakness that decreased over time in most patients after the operation[19, 20]. In OVCF patients, cement leakage is common complications after PVP[21], which may cause fractures in the adjacent vertebral body[22], and in severe cases, it may leak into the vertebral veins or spinal canal[23]. Although around one quarter of OVCF patients experienced cement leakage in the study, no one needed further surgery. The complication rates observed were comparable to published studies and similar between groups for all three conditions, suggesting that these events are more related to surgical technical factors

and patient selection rather than discharge timing. Early discharge did not increase the risk of unrecognized or inadequately managed adverse events.

Among patients planned for day surgery, 90% were successfully discharged within 24 hours. The most common reason for delayed discharge was poor pain control on postoperative day 1. In OVCF patients with long duration usually have myofascitis of the back region, which were the main causes of residual postoperative back pain and delayed discharge[24]. These patients require additional physical therapy, such as thin silver needle thermal therapy. For complex cases involving multiple segments or a long disease course, the traditional admission is still the preferred option.

The economic advantages were comparable across the three diseases. With about 80% of patients were covered by health insurance, 13%–15% reduction in direct medical costs represents meaningful healthcare savings. Shorter hospital days also improved bed turnover rates and reduced patients waiting times. Given that chronic pain affects about 27.5% of the global population, and reaching 27%–60% among individuals over 60 years old[25], demand for pain management is increasing. Most interventional pain procedures are minimally invasive, image-guided, and do not require complex preoperative preparation or postoperative recovery procedures. Under China's Diagnosis-Related Groups/Diagnosis-Based Payment (DRG/DIP) reform[26], day surgery for these common pain diseases is an optimal strategy for controlling costs and enhancing efficiency, and pain medicine is well suited to this model [27].

Most patient were elderly people who were in need of the company and care, they would rather be at home with their relatives than be stuck in hospital. As the core concept of

Enhanced Recovery After Surgery (ERAS) states, the key to ensuring treatment efficacy and patient satisfaction lies in process optimization, rather than simply prolonging the hospital stays[28].

This study also has certain limitations. First, its retrospective nature means that despite IPTW adjustment, factors such as patient preferences, social support, and so on may have influenced both the choice of surgical setting and recovery outcomes. Some important functional assessments were not included, such as the Barrow Neurological Institute (BNI) pain score, the Oswestry Disability Index (ODI) score, and the Constant-Murley shoulder (CMS) score. Second, the follow-up period of 90 days is insufficient to evaluate very long-term outcomes (e.g., TN recurrence). Third, the single-center design may limit generalizability. A prospective randomized controlled study exploring the application of day surgery in the pain medicine should be performed in healthcare institutions of different levels and resource allocations. Finally, our cost analysis only covered direct medical expenses. Future research should evaluate the indirect costs for patients and families (e.g., lost wages, transportation expenses) and the proportion of medical insurance reimbursement, clarifying the value of day surgery model in reducing the economic burden on patients and the national medical insurance system.

Conclusion

For appropriately selected patients with FS, TN, or OVCF, day surgery for minimally invasive pain interventions is a safe and effective strategy in pain medicine. This model can significantly reduce medical costs and more efficiently utilize hospital resources while maintaining the same level of pain control and safety. Therefore, the day surgery model is

worthy of wide promotion and application in pain medicine.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Declarations

Ethics approval and consent to participate

This retrospective study was approved by the Medical Ethics Committee of Nanjing Drum Tower Hospital (No. 2025-0604-01). The requirement for written informed consent was waived due to the retrospective nature of the study.

Competing interests

The authors declare that they have no competing interests.

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Not applicable.

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Table 1. Demographic and clinical characteristics of FS patients before and after IPTW.

FS	Before IPTW			After IPTW			
Variables	TIG (n = 81)	DSG (n = 62)	*p*	TIG* (n=81.4)	DSG* (n=61.91)	*p*	SMD
Age, years, mean (SD)	56.69 (8.96)	54.92 (8.87)	0.241	56.20 (9.37)	56.28 (9.16)	0.964	0.008
Female, n (%)	53 (65.4)	40 (64.5)	1	52.8 (64.9)	41.2 (66.5)	0.848	0.034
BMI, kg/m², mean (SD)	23.13 (3.01)	23.64 (3.51)	0.345	23.30 (3.15)	23.23 (3.49)	0.902	0.022
Duration of symptoms, months, mean (SD)	4.72 (2.96)	5.03 (2.45)	0.497	4.94 (3.05)	4.91 (2.48)	0.938	0.014
Comorbidities, n (%)							

Hypertension	22 (27.2)	16(25.8)	1	22.4 (27.5)	16.6 (26.9)	0.935	0.015
Diabetes	14 (17.3)	12 (19.4)	0.921	15.0 (18.4)	10.6(17.1)	0.851	0.033
Heart disease	1 (1.2)	2 (3.2)	0.814	1.8 (2.3)	1.4 (2.2)	0.985	0.003
Malignancy	2 (2.5)	3 (4.8)	0.76	3.8 (4.7)	2.7 (4.3)	0.923	0.019
Affected side, n (%)							
Left	44 (54.3)	26 (41.9)	0.194	38.6 (47.4)	29.5 (47.7)	0.974	0.006
Right	37 (45.7)	36 (58.1)		42.8 (52.6)	32.4 (52.3)		
Baseline VAS, mean (SD)	6.15 (0.92)	5.94 (1.05)	0.201	6.05 (0.94)	6.06 (1.07)	0.934	0.015
Medical payments, n (%)							
Urban employee basic medical insurance	68 (84.0)	53 (85.5)	0.968	68.8 (84.6)	52.1 (84.1)	0.993	0.02
Urban resident basic medical insurance	3 (3.7)	2 (3.2)		3.1 (3.8)	2.6 (4.1)		
At their own expense	10 (12.3)	7 (11.3)		9.5 (11.7)	7.3 (11.7)		

BMI, body mass index; DSG, day surgery group; IPTW = inverse probability of treatment weighting; SMD, standardized mean difference; TIG, traditional inpatient group; VAS = Visual Analog Scale.

* Weighted n values are effective sample sizes after IPTW truncation, rounded to one decimal place.

Table 2. Demographic and clinical characteristics of TN patients before and after IPTW.

TN	Before IPTW			After IPTW			
Variables	TIG (n = 215)	DSG (n = 89)	*p*	TIG* (n=213.5)	DSG* (n=85.7)	*p*	SMD
Age, years, mean (SD)	70.98 (34.94)	69.00 (10.30)	0.6	70.57 (30.28)	69.18 (10.01)	0.512	0.062

Female, n (%)	137 (63.7)	67 (75.3)	0.069	144.8 (67.8)	60.3 (70.3)	0.695	0.055
BMI, kg/m², mean (SD)	23.69 (3.67)	24.22 (3.49)	0.246	23.83 (3.57)	23.99 (3.36)	0.714	0.046
Duration of symptoms, months, mean (SD)	58.88 (62.81)	65.76 (85.02)	0.436	60.18 (63.98)	60.98 (78.49)	0.932	0.011
Comorbidities, n (%)							
Hypertension	103 (47.9)	51 (57.3)	0.172	107.8 (50.5)	43.8 (51.0)	0.934	0.011
Diabetes	23 (10.7)	19 (21.3)	0.023	30.5 (14.3)	13.7 (16.0)	0.701	0.049
Heart disease	9 (4.2)	13 (14.6)	0.003	14.0 (6.5)	6.2 (7.3)	0.802	0.029
Malignancy	6 (2.8)	2 (2.2)	1	6.0 (2.8)	2.6 (3.1)	0.922	0.014
Affected side, n (%)							
Left	88 (40.9)	42 (47.2)	0.381	91.2 (42.7)	37.4 (43.7)	0.886	0.019
Right	127 (59.1)	47 (52.8)		122.2 (57.3)	48.3 (56.3)		

Branches affected, n (%)							
I	9 (4.2)	2 (2.2)	0.852	7.1 (3.3)	2.5 (2.9)	0.971	0.123
II	85 (39.5)	35 (39.3)		85.2 (39.9)	36.0 (42.0)		
III	78 (36.3)	37 (41.6)		82.4 (38.6)	35.0 (40.9)		
I & II	9 (4.2)	3 (3.4)		8.2 (3.8)	3.2 (3.7)		
I & III	31 (14.4)	10 (11.2)		27.5 (12.9)	7.9 (9.2)		
I - III	3 (1.4)	2 (2.2)		3.1 (1.4)	1.1 (1.3)		
Recurrent TN, n (%)	63 (29.3)	25 (28.1)	0.942	62.8 (29.4)	23.8 (27.8)	0.787	0.036
Baseline VAS, mean (SD)	6.44 (0.94)	6.44 (0.96)	0.993	6.43 (0.94)	6.46 (0.93)	0.808	0.031
Medical payments, n (%)							
Urban employee basic medical insurance	142 (66.7)	55 (61.8)	0.643	139.3 (65.3)	56.3 (65.7)	0.993	0.015
Urban resident basic medical insurance	30 (14.1)	16 (18.0)		32.0 (15.0)	12.4 (14.5)		
At their own expense	41 (19.	18 (20.2)		42.2 (19.8)	17.0 (19.9)		

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BMI, body mass index; DSG, day surgery group; IPTW = inverse probability of treatment weighting; SMD, standardized mean difference; TIG, traditional inpatient group; VAS = Visual Analog Scale.

* Weighted n values are effective sample sizes after IPTW truncation, rounded to one decimal place.

Table 3. Demographic and clinical characteristics of OVCF patients before and after IPTW.

OVCF	Before IPTW			After IPTW			
Variables	TIG (n = 357)	DSG (n = 126)	*p*	TIG* (n=356.99)	DSG* (n=123.02)	*p*	SMD

Age, years, mean (SD)	73.02 (9.35)	74.44 (9.09)	0.139	73.38 (9.27)	73.53 (9.14)	0.878	0.016
Female, n (%)	296 (82.9)	105 (83.3)	1	296.1 (82.9)	101.6 (82.6)	0.931	0.009
BMI, kg/m², mean (SD)	23.10 (3.16)	23.08 (2.72)	0.967	23.11 (3.14)	23.20 (2.78)	0.76	0.032
Duration of symptoms, months, mean (SD)	14.47 (19.80)	14.40 (16.70)	0.971	14.43 (19.89)	14.15 (16.71)	0.879	0.015
Comorbidities, n (%)							
Hypertension	168 (47.1)	64 (50.8)	0.537	170.9 (47.9)	57.7 (46.9)	0.852	0.02
Diabetes	49 (13.7)	17 (13.5)	1	48.9 (13.7)	17.2 (13.9)	0.945	0.007
Heart disease	42 (11.8)	10 (7.9)	0.305	38.3 (10.7)	11.8 (9.6)	0.745	0.037
Malignancy	31 (8.7)	6 (4.8)	0.219	27.3 (7.7)	8.4 (6.8)	0.789	0.032
Fracture level, n (%)							

Thoracic (T5–T10)	58 (16.2)	21 (16.7)	0.055	58.6 (16.4)	21.8 (17.7)	0.895	0.053
Thoracolumbar (T11–L2)	229 (64.1)	92 (73.0)		237.1 (66.4)	82.2 (66.8)		
Lumbar (L3–L5)	70 (19.6)	13 (10.3)		61.3 (17.2)	19.0 (15.5)		
Baseline VAS, mean (SD)	5.82 (1.14)	5.75 (1.21)	0.519	5.80 (1.14)	5.78 (1.20)	0.867	0.018
Medical payments, n (%)							
Urban employee basic medical insurance	258 (72.3)	96 (76.2)	0.381	261.5 (73.2)	90.2 (73.3)	0.999	0.006
Urban resident basic medical insurance	51 (14.3)	19 (15.1)		51.7 (14.5)	17.9 (14.5)		
At their own expense	48 (13.4)	11 (8.7)		43.9 (12.3)	14.9 (12.1)		

BMI, body mass index; DSG, day surgery group; IPTW = inverse probability of treatment weighting; SMD, standardized mean difference; TIG, traditional inpatient group; VAS = Visual Analog Scale.

* Weighted n values are effective sample sizes after IPTW truncation, rounded to one decimal place.

Table 4. Comparison of complications between groups after IPTW.

Variables	TIG	DSG	*p*
TN, n (%)			
Facial swelling	36.0 (16.8)	12.4 (14.5)	0.613
Nausea and vomit	9.4 (4.4)	6.0 (7.0)	0.365
Masseter weakness	175.1 (82.0)	67.0 (78.1)	0.473
OVCF, n (%)			
Cement leakage	99.8 (28.0)	33.8 (27.5)	0.925

DSG, day surgery group; TIG, traditional inpatient group.

Table 5. Comparison of variables during hospitalization between groups after IPTW.

Variables	TIG	DSG	*p*
FS			
Hospital costs, RMB, mean (SD)	7633.55 (1296.12)	6643.21 (719.26)	<0.001
Hospital stays, days, mean (SD)	2.43 (1.66)	1.90 (1.18)	0.028
Satisfaction, mean (SD)	9.12 (0.75)	9.40 (0.81)	0.043
Delayed discharge, n (%)	-	13 (21.0)	
TN			
Hospital costs, RMB, mean (SD)	6068.33 (1788.94)	5188.52 (1187.26)	<0.001
Hospital stays, days, mean (SD)	2.98 (1.42)	1.61 (0.67)	<0.001
Satisfaction, mean (SD)	9.18 (0.79)	9.54 (0.60)	<0.001
Delayed discharge, n (%)	-	3 (3.4)	
OVCF			
Hospital costs, RMB, mean (SD)	9297.95 (2041.18)	7827.72 (1858.74)	<0.001
Hospital stays, days, mean (SD)	3.53 (1.49)	1.86 (0.65)	<0.001
Satisfaction, mean (SD)	9.28 (0.61)	9.51 (0.58)	<0.001
Delayed discharge, n (%)	-	11 (8.7)	

DSG, day surgery group; TIG, traditional inpatient group.

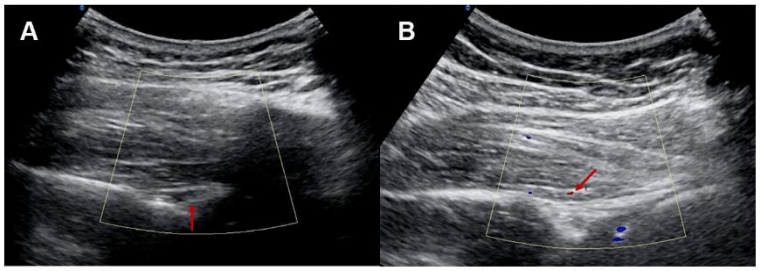


Figure 1. Ultrasound-guided puncture of suprascapular nerve (A) and axillary nerve (B).



Figure 2. Axial CT image showing the puncture of the foramen ovale (the red arrow points to the needle).

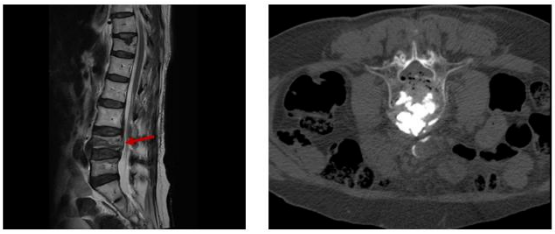
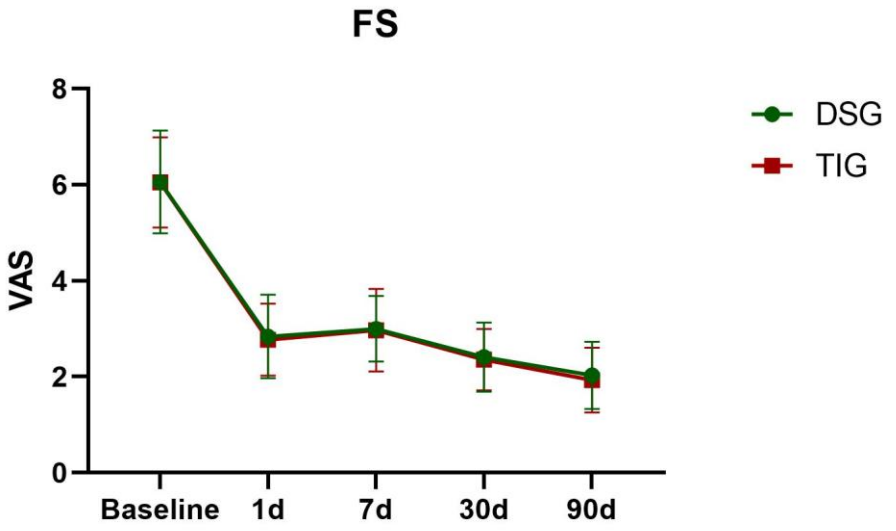
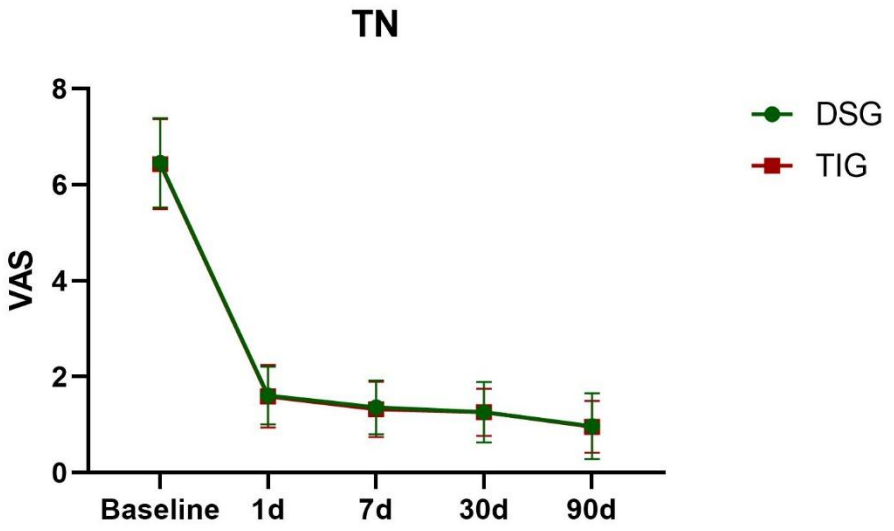


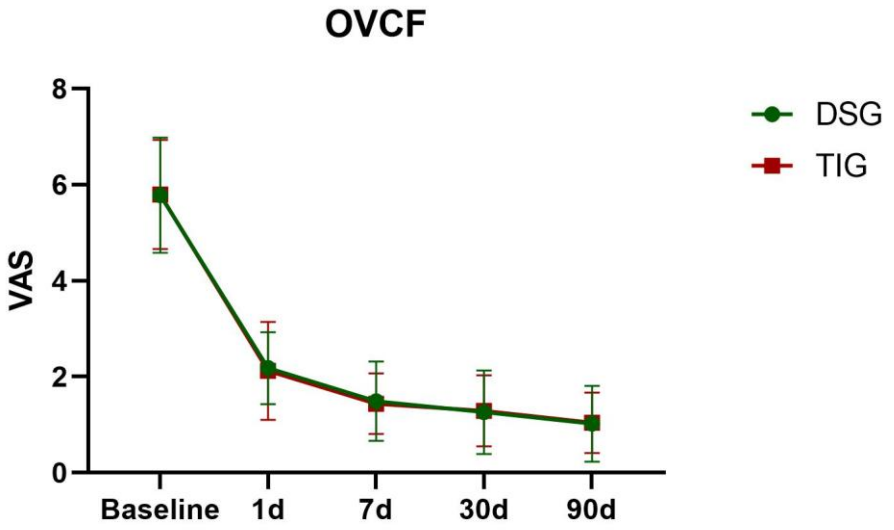
Figure 3. L4 vertebral compression fracture: MRI image before (A, the red arrow points to the L4 vertebra) and CT image after (B) percutaneous vertebroplasty.



sFigure 1. GEE model results for VAS scores over time in FS patients. Time effect: β = -0.865 (95% CI: -0.926 to -0.804), p < 0.001. Group effect: β = 0.006 (95% CI: -0.390 to 0.402), p = 0.980. Group×time interaction: β = 0.015 (95% CI: -0.069 to 0.099), p = 0.730. GEE, generalized estimating equation; VAS, Visual Analog Scale.



sFigure 2. GEE model results for VAS scores over time in TN patients.
Time effect: β = -1.128 (95% CI: -1.157 to -1.099), p < 0.001. Group effect: β = 0.037 (95% CI: -0.187 to 0.261), p = 0.747. Group×time interaction: β = -0.006 (95% CI: -0.065 to 0.053), p = 0.834. GEE, generalized estimating equation; VAS, Visual Analog Scale.



sFigure 3. GEE model results for VAS scores over time in OVCF patients.
Time effect: β = -1.036 (95% CI: -1.068 to -1.004), p < 0.001. Group effect (DSG vs TIG): β = 0.032 (95% CI: -0.195 to 0.260), p = 0.779. Group × Time interaction: β = -0.008 (95% CI: -0.070 to 0.053), p = 0.788. GEE, generalized estimating equation; VAS, Visual Analog Scale.