To Explore the Effects of Multidisciplinary Collaborative Nursing on Clinical Outcomes in Patients Undergoing Skull Defect Repair

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AIM: To explore the effects of the multidisciplinary collaborative nursing model on neurological function, cognitive function, depressive symptoms, and quality of life in patients with cranioplasty (i.e., surgical repair of skull defects).
METHODS: This is a single-center retrospective study. A total of 101 patients who underwent skull defect repair at The First People's Hospital of Jiashan from June 2022 to November 2025 were selected as the study population. Patients were divided into two groups based on sequential temporal cohorts: those treated before the implementation of the multidisciplinary collaborative nursing protocol (June 2022 to October 2023) were designated as the control group (n = 54), whereas those treated after its hospital-wide implementation (November 2023 to November 2025) served as the observation group (n = 47). The control group received routine nursing, while the observation group received multidisciplinary collaborative nursing, including multidisciplinary team formation, preoperative psychological counseling and rehabilitation guidance, postoperative rehabilitation training, dynamic assessment of psychological status, and continuous nursing guidance after discharge. Neurological function, cognitive function, anxiety/depression, and self-care ability were assessed using the National Institutes of Health Stroke Scale (NIHSS), Mini-Mental State Examination (MMSE), Hospital Anxiety and Depression Scale (HADS), and Activities of Daily Living (ADL), respectively. Quality of life was measured with the General Quality of Life Inventory-74 (GQOLI-74), and postoperative complications were documented.
RESULTS: Before the intervention, no significant differences were observed between the two groups in any of the measured indices ($p > 0.05$). After the intervention, both groups demonstrated improvement in neurological and cognitive function, as well as reductions in anxiety and depression scores; however, the observation group showed significantly greater improvements compared with the control group. The observation group showed significantly lower NIHSS scores than the control group ($p = 0.02$), along with significantly higher MMSE scores ($p < 0.01$). Both HADS-A ($p < 0.01$) and HADS-D scores ($p < 0.05$) were significantly reduced in the observation group compared with the control group. The ADL score of the observation group was also significantly higher than that of the control group ($p = 0.01$). Regarding quality of life, the observation group demonstrated significantly higher scores in the psychological ($p < 0.01$), social ($p = 0.03$), and physical dimensions ($p < 0.01$), while no significant difference was found in the material dimension ($p = 0.30$). Furthermore, the overall complication rate was significantly lower in the observation group ($p = 0.04$).
CONCLUSIONS: Multidisciplinary collaborative nursing markedly improves neurological and cognitive function in patients undergoing skull defect repair, effectively alleviates anxiety and depression, enhances daily living self-care ability and quality of life, and reduces the incidence of postoperative complications.

Keywords: skull defect; cranioplasty; multidisciplinary collaborative nursing; neurological function; quality of life; depressive symptoms

Introduction

Skull defect is one of the sequelae after decompressive craniectomy, which can be caused by traumatic brain injury, cerebrovascular accident, intracranial infection, and other etiologies [1]. Studies have shown that skull defect can cause a series of clinical symptoms, mainly manifested as persistent headache, cognitive dysfunction, motor function defect, and neurological decline [2,3]. Its pathophysiological mechanism is mainly related to an imbalance in intracranial pressure homeostasis, disorders of cerebrospinal fluid dynamics, and changes in cerebral blood flow resulting from the destruction of cranial cavity integrity [4]. Skull defect repair has been proven to significantly improve neurological and cognitive function, as well as cerebral perfusion, by reconstructing the anatomical integrity of the skull cavity and re-establishing intracranial physiological homeostasis.

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The improvement of neurological and cognitive function after cranioplasty has been widely recognized. A significant increase in cerebral blood flow, notably in the ipsilateral middle cerebral artery territory, has been observed after cranioplasty and is closely associated with improved neurological outcomes [4], and cranioplasty can significantly improve cerebral perfusion parameters and neurocognitive outcomes. Additional research demonstrated significant improvements in both Activities of Daily Living and quality of life after cranioplasty [5]. However, the complications after skull defect repair have always been the focus of clinical attention. Common complications include incision infection, subcutaneous effusion, flap depression, bone flap resorption, and nonunion. In a retrospective analysis of 107 patients undergoing titanium alloy cranioplasty, Korhonen et al. [6] reported that 22% experienced at least one complication and 12% developed surgical site infections. The risk of infection is closely related to the patient's overall clinical condition, cerebrospinal fluid shunt placement, and other factors. In a study on 355 cases of cranioplasty, Houskamp et al. [7] found that the overall complication rate was 32.2%. These complications prolong the length of hospital stay, increase medical costs, delay the process of neurological rehabilitation, and adversely affect the prognosis of patients. Furthermore, the psychological burden of patients associated with skull defects cannot be ignored. Skull defects not only cause appearance defects but also lead to negative psychological outcomes. Ashayeri et al. [8] pointed out that in addition to neurological deficits, skull defect syndrome also includes psychosocial dysfunction. Skull defect patients frequently experience varying levels of anxiety and depression, which can undermine their adherence to rehabilitation and diminish their quality of life [9]. Unlike general surgical scars, the contour deformity of the cranial vault is directly visible and often cannot be fully concealed by hair or clothing, leading to profound alterations in body image and self-esteem [10]. Moreover, the absence of bony protection leaves patients with a persistent fear of direct brain injury from even minor head impacts, a concern that is unique and rarely observed in other surgical populations. Consequently, many patients adopt avoidance behaviors, such as withdrawing from social activities or refusing to return to work, due to embarrassment about their appearance or fear of accidental injury, resulting in progressive social isolation. These distinct psychosocial stressors—altered body image, fear of vulnerability, and social withdrawal—may specifically predispose patients to depressive symptoms, which differs from general anxiety or depression [9]. However, systematic studies on depressive symptoms in patients after cranioplasty are still limited.

Multidisciplinary collaborative nursing has gained wide acceptance in the surgical field over recent years. This model integrates a multidisciplinary team, including neurosurgeons, rehabilitation therapists, psychologists, nutritionists, and specialist nurses, to provide patients with comprehensive, systematic, and individualized treatment and nursing programs. Houskamp et al. [7] also showed that multidisciplinary surgical teams are more often used in high-risk and complex cranioplasty cases, supporting the value of multidisciplinary collaboration in cranioplasty. A study reported that preoperative cooperation between neurosurgeons and plastic surgeons can optimize the skin condition over the surgical site and minimize the risk of postoperative complications [11]. These studies provide an important basis for the application of multidisciplinary collaboration in cranioplasty.

However, systematic studies investigating the effects of the multidisciplinary collaborative nursing model on the neurological function and psychological status in patients with skull defect repair remain limited. Most studies have focused on surgical techniques, materials, or complications, neglecting the holistic effect of multidisciplinary nursing. This retrospective study therefore examined its impact on neurological function, cognition, and depressive symptoms to provide evidence-based guidance for skull defect repair nursing.

Methods

Study Population

This is a single-center retrospective study. The study was approved by the Ethics Committee of The First People's Hospital of Jiashan (2026 Research No. 044) and was conducted in accordance with the Declaration of Helsinki. A total of 101 patients who underwent skull defect repair in The First People's Hospital of Jiashan between June 2022 and November 2025 were selected as the research subjects. Inclusion criteria: ① patients met the diagnostic criteria of skull defect and underwent skull defect repair; ② availability of complete clinical data. Exclusion criteria: ① complicated with severe heart, liver, and kidney dysfunction; ② complicated with malignant tumors; ③ previous history of mental illness or cognitive impairment; ④ patients involved in medical disputes; ⑤ patients who died during the follow-up period; ⑥ pregnant or lactating women. According to the timing of admission, patients treated from June 2022 to October 2023, all of whom received routine nursing following skull defect repair, were assigned to the control group (n = 54). From November 2023 to November 2025, after the hospital formally implemented the multidisciplinary collaborative nursing protocol for all eligible patients, those receiving surgery were assigned to the observation group (n = 47). The control group received routine nursing, while the observation group received multidisciplinary collaborative nursing.

Surgical Procedures

All patients underwent elective cranioplasty under general anesthesia. The surgical approach was standardized: through a previous scalp incision, the soft tissue was carefully dissected to expose the bone defect margin, followed

by dura mater inspection and repair if necessary. The cranial defect was reconstructed using preformed titanium mesh or polyetheretherketone (PEEK), with the choice of material determined by intraoperative assessment and material availability. The implant was fixed with titanium screws. A subgaleal drain was routinely placed before wound closure. All procedures were performed by the same neurosurgical team to minimize variability of surgical technique.

Nursing Methods

Routine nursing (preoperative education, postoperative vital signs monitoring, wound care, medication guidance, and discharge guidance) was given to the control group. The observation group received multidisciplinary collaborative nursing in addition to routine care, with the specific measures described below: ① establishment of a multidisciplinary team: the multidisciplinary team was composed of neurosurgeons, rehabilitation therapists, psychiatrists, nutritionists, and specialist nurses to formulate individualized nursing programs together using a standardized checklist. ② Preoperative intervention: psychiatrists evaluated anxiety and depression using Hospital Anxiety and Depression Scale (HADS) and provided two 30-minute counseling sessions based on cognitive-behavioral therapy (CBT) principles, including psychoeducation about the skull defect and repair, identification and restructuring of negative automatic thoughts related to appearance and fear of brain injury, and relaxation training (deep breathing and progressive muscle relaxation). Rehabilitation therapists guided patients to perform preoperative rehabilitation training, including range-of-motion exercises for limbs (10 repetitions per joint, twice daily) and respiratory training (deep breathing and coughing exercises, 5 minutes every 2 hours). A dietitian assessed nutritional status using the Nutritional Risk Screening 2002 (NRS-2002) tool and serum albumin levels, and formulated personalized diet plans with specific targets (e.g., daily protein intake ≥1.2 g/kg, serum albumin >35 g/L). ③ Postoperative intervention: rehabilitation therapists developed stage-specific rehabilitation plans according to patients' neurological function. The rehabilitation program was initiated on postoperative day 2 and consisted of three phases: phase 1 (postoperative days 2–3): passive range-of-motion exercises for all four limbs (10 repetitions per joint, twice daily) and bed mobility training; phase 2 (postoperative days 4–7): active-assisted exercises, sitting balance training (10 minutes twice daily), and gradual ambulation with assistance; phase 3 (postoperative day 7 to discharge): independent ambulation, standing balance training (15 minutes twice daily), and Activities of Daily Living training (dressing, bathing, and toileting). Each training session lasted approximately 30 minutes and was supervised by a rehabilitation therapist. Psychological intervention was triggered when HADS-A or HADS-D score ≥11 or increased by ≥3 points, consisting of four weekly 45-minute sessions focusing on body image acceptance, fear management regarding brain injury, and social reintegration skills. After discharge, continuous nursing guidance was provided through structured telephone follow-up at 1, 4, and 12 weeks post-discharge (lasting approximately 15 minutes per call, covering medication adherence, wound condition, rehabilitation compliance, and psychological well-being), WeChat platform, and other communication methods.

Observation Indicators

Neurological function was assessed using the National Institutes of Health Stroke Scale (NIHSS, 0–42 points, with higher scores indicating more severe deficits), and cognitive function was evaluated with the Mini-Mental State Examination (MMSE, 0–30 points, where higher scores reflect better cognition). Anxiety and depression were measured using the HADS, including the anxiety subscale (HADS-A) and depression subscale (HADS-D), each ranging from 0 to 21 points, with higher scores indicating more severe symptoms. Self-care ability was assessed by the Activities of Daily Living (ADL, 0–100 points) scale, with higher scores denoting better function. Quality of life was evaluated using the General Quality of Life Inventory-74 (GQOLI-74) across four dimensions (psychological, material, social, and physical), each scored on a scale of 0–100, with higher scores indicating better quality of life. The postoperative complications of patients were collected, including flap depression, incision infection, subcutaneous effusion, bone flap resorption, and nonunion.

Statistical Methods

Data were analyzed using SPSS 26.0 (IBM Corp., Armonk, NY, USA). Normality of continuous data was assessed using the Shapiro-Wilk test. Normally distributed data were expressed as mean ± SD and compared using the independent samples *t*-test. Non-normally distributed data were presented as median (Q_1, Q_3) and compared using the Mann-Whitney U test. Categorical data were expressed as frequencies (percentages) and compared using the chi-square test or Fisher's exact test. A $p < 0.05$ was considered statistically significant.

Results

Baseline Data of Patients

There was no significant difference in age ($p = 0.46$), gender ($p = 0.38$), cause of injury ($p = 0.80$), injury site ($p = 1.00$), defect time ($p = 0.65$), marital status ($p = 1.00$), area of skull defect ($p = 0.46$), duration of surgery ($p = 0.27$), repair material ($p = 0.70$), hypertension ($p = 0.96$), and diabetes ($p = 0.50$) between the two groups, as shown in Table 1.

Table 1. Baseline data of patients.

Variables	Total (n = 101)	Observation group (n = 47)	Control group (n = 54)	Statistic	*p*
Age, mean ± SD	44.11 ± 8.36	43.45 ± 8.48	44.69 ± 8.28	$t = -0.74$	0.46
Gender, n (%)				$\chi^2 = 0.77$	0.38
Male	52 (51.49)	22 (46.81)	30 (55.56)		
Female	49 (48.51)	25 (53.19)	24 (44.44)		
Cause of injury, n (%)				$\chi^2 = 0.07$	0.80
Traumatic skull defect	89 (88.12)	41 (87.23)	48 (88.89)		
Non-traumatic skull defects	12 (11.88)	6 (12.77)	6 (11.11)		
Site of injury, n (%)				$\chi^2 = 0.05$	1.00
Forehead	38 (37.62)	18 (38.30)	20 (37.04)		
Occipital	26 (25.74)	12 (25.53)	14 (25.93)		
Parieto-occipital	19 (18.81)	9 (19.15)	10 (18.52)		
Temporal	18 (17.82)	8 (17.02)	10 (18.52)		
Duration of skull defect, n (%)				$\chi^2 = 0.21$	0.65
>3 months	28 (27.72)	12 (25.53)	16 (29.63)		
≤3 months	73 (72.28)	35 (74.47)	38 (70.37)		
Marital status, n (%)					1.00
Married	93 (92.08)	43 (91.49)	50 (92.59)		
Unmarried	8 (7.92)	4 (8.51)	4 (7.41)		
Area of skull defect (cm^2), M (Q_1, Q_3)	111.90 (91.90, 131.60)	111.40 (92.05, 128.30)	112.85 (91.33, 135.60)	Z = –0.75	0.46
Duration of surgery (min), M (Q_1, Q_3)	203.00 (195.00, 213.00)	203.00 (191.50, 212.50)	203.50 (197.25, 213.75)	Z = –1.10	0.27
Repair material, n (%)				$\chi^2 = 0.15$	0.70
Polyetheretherketone	24 (23.76)	12 (25.53)	12 (22.22)		
Titanium mesh	77 (76.24)	35 (74.47)	42 (77.78)		
Hypertension, n (%)				$\chi^2 = 0.00$	0.96
No	84 (83.17)	39 (82.98)	45 (83.33)		
Yes	17 (16.83)	8 (17.02)	9 (16.67)		
Diabetes, n (%)					0.50
No	92 (91.09)	44 (93.62)	48 (88.89)		
Yes	9 (8.91)	3 (6.38)	6 (11.11)		

Note: χ^2 or Fisher's exact test for categorical data (Fisher's exact test used when expected cell count <5).

Comparison of Neurological Function and Anxiety and Depression Scores

The two groups had comparable item scores at baseline ($p > 0.05$). After intervention, both groups showed improvements in all measures; however, the observation group demonstrated consistently greater improvements than the control group across all outcomes. The observation group had a lower NIHSS score than the control group ($p = 0.02$), a higher MMSE score ($p < 0.01$), and lower HADS-A ($p < 0.01$) and HADS-D scores ($p < 0.05$), as shown in Table 2.

Assessment of Quality of Life and Self-Care Ability

ADL and quality of life scores did not differ significantly between groups at baseline ($p > 0.05$). After intervention, both groups showed improvement in ADL and quality of life scores; however, the observation group demonstrated significantly greater improvement. The observation group exhibited a higher ADL score than the control group ($p = 0.01$). The observation group exhibited higher scores of psychological, social, and physical dimensions of quality of life than the control group ($p < 0.05$), and no significant difference was observed in the material dimension ($p = 0.30$). (Table 3).

Comparison of Complication Rates

The observation group had a lower overall complication rate than the control group ($p = 0.04$). There were no statistically significant differences in each specific complication (flap depression, incision infection, subcutaneous effusion, bone flap resorption, and nonunion) between the two groups ($p > 0.05$) (Table 4).

Discussion

This study explored the effect of the multidisciplinary collaborative nursing model on neurological function and depressive symptoms in patients with skull defect repair. Compared with the control group, multidisciplinary collaborative nursing yielded significantly better outcomes in neurological and cognitive recovery, mood regulation, quality of life, and complication prevention.

The observation group had significantly lower NIHSS scores and higher MMSE scores than the control group

Table 2. Comparison of neurological function and anxiety and depression scores.

Variables	Total (n = 101)	Observation group (n = 47)	Control group (n = 54)	Statistic	*p*
NIHSS, M (Q_1, Q_3)					
Baseline	14.00 (12.00, 17.00)	16.00 (12.00, 17.00)	14.00 (11.00, 17.00)	Z = –0.87	0.38
3 months	8.00 (7.00, 11.00)	8.00 (6.00, 9.50)*	9.50 (7.00, 13.00)*	Z = –2.40	0.02
MMSE, mean ± SD					
Baseline	16.17 ± 3.41	16.23 ± 2.92	16.11 ± 3.80	*t* = 0.18	0.86
3 months	22.34 ± 3.46	24.02 ± 3.17*	20.87 ± 3.03*	*t* = 5.10	<0.01
HADS-A, M (Q_1, Q_3)					
Baseline	8.00 (6.00, 9.00)	8.00 (6.00, 9.00)	8.00 (6.00, 9.00)	Z = –0.18	0.86
3 months	5.00 (4.00, 8.00)	5.00 (3.00, 7.00)*	7.00 (5.00, 8.00)*	Z = –3.32	<0.01
HADS-D, M (Q_1, Q_3)					
Baseline	8.00 (7.00, 11.00)	8.00 (7.00, 11.50)	8.00 (7.00, 11.00)	Z = –0.24	0.81
3 months	6.00 (5.00, 9.00)	5.00 (4.00, 8.00)*	6.00 (5.00, 9.00)*	Z = –1.98	<0.05

* indicates $p < 0.05$ compared with the baseline. NIHSS, National Institutes of Health Stroke Scale; MMSE, Mini-Mental State Examination; HADS, Hospital Anxiety and Depression Scale.

Table 3. Assessment of quality of life and self-care ability.

Variables	Total (n = 101)	Observation group (n = 47)	Control group (n = 54)	Statistic	*p*
ADL, mean ± SD					
Baseline	59.35 ± 6.95	60.09 ± 6.37	58.70 ± 7.42	*t* = 1.00	0.32
3 months	74.64 ± 6.16	76.70 ± 6.02*	72.85 ± 5.75*	*t* = 3.28	0.01
Psychological, mean ± SD					
Baseline	63.96 ± 5.05	63.89 ± 5.12	64.02 ± 5.03	*t* = –0.12	0.90
3 months	72.75 ± 6.49	75.81 ± 6.23*	70.09 ± 5.51*	*t* = 4.89	<0.01
Material, mean ± SD					
Baseline	76.14 ± 3.36	75.62 ± 3.69	76.59 ± 3.01	*t* = –1.46	0.15
3 months	76.67 ± 4.36	76.19 ± 4.58	77.09 ± 4.16	*t* = –1.04	0.30
Society, mean ± SD					
Baseline	56.96 ± 8.20	56.83 ± 8.28	57.07 ± 8.21	*t* = –0.15	0.88
3 months	70.65 ± 5.58	72.04 ± 7.14*	69.44 ± 3.37*	*t* = 2.28	0.03
Physical, mean ± SD					
Baseline	63.56 ± 5.49	63.40 ± 4.92	63.70 ± 5.98	*t* = –0.27	0.79
3 months	71.97 ± 4.82	74.00 ± 5.10*	70.20 ± 3.80*	*t* = 4.28	<0.01

* indicates $p < 0.05$ compared with the baseline. ADL, Activities of Daily Living.

post-intervention, indicating that multidisciplinary collaborative nursing effectively promotes neurological and cognitive recovery after skull defect repair. The reason may be related to the integration of multi-professional forces in this model [12]. Neurosurgeons provide specialist guidance, and rehabilitation therapists formulate phased rehabilitation plans based on patients' neurological function, including motor and balance training, thereby promoting neuroplasticity and accelerating functional reconstruction. Specialist nurses integrated rehabilitation goals into daily nursing operations to ensure the continuity of care and rehabilitation.

Skull defect patients frequently suffer from low self-esteem, anxiety, and depression caused by cosmetic deformities and functional limitations. Baseline median HADS-A and HADS-D scores were 8.00 in both groups, reflecting mild anxiety and depression. Post-intervention, the observation group had significantly lower HADS scores than the control group, indicating that multidisciplinary collaborative nursing effectively reduces anxiety and depression. The mechanism may be related to the following factors: first, early intervention and targeted psychological counseling by psychologists can help patients establish a positive coping style; second, regular follow-up and psychological status assessment by nurses in charge enable timely detection of psychological problems and intervention; third, the improvement of neurological function and the reduction of complications enhance patients' confidence in recovery, forming a virtuous circle. This result is consistent with the conclusions of multidisciplinary collaborative nursing research in other disease fields. A randomized controlled study by Yang et al. [13] on patients with hepatocellular carcinoma after surgery showed that the HADS-A score and HADS-D score of patients receiving multidisciplinary collaborative nursing were significantly lower than those in the routine nursing group at 6 months after surgery, and the incidence and degree of anxiety were also signif-

Table 4. Comparison of complication rates.

Variables	Total (n = 101)	Observation group (n = 47)	Control group (n = 54)	Statistic	*p*
Incidence rate, n (%)				$\chi^2 = 4.19$	0.04
No	79 (78.22)	41 (87.23)	38 (70.37)		
Yes	22 (21.78)	6 (12.77)	16 (29.63)		
Flap depression, n (%)					0.68
No	95 (94.06)	45 (95.74)	50 (92.59)		
Yes	6 (5.94)	2 (4.26)	4 (7.41)		
Incision infection, n (%)					0.25
No	98 (97.03)	47 (100.00)	51 (94.44)		
Yes	3 (2.97)	0 (0.00)	3 (5.56)		
Subcutaneous effusion, n (%)					0.33
No	91 (90.10)	44 (93.62)	47 (87.04)		
Yes	10 (9.90)	3 (6.38)	7 (12.96)		
Bone flap absorption and nonunion, n (%)					1.00
No	98 (97.03)	46 (97.87)	52 (96.30)		
Yes	3 (2.97)	1 (2.13)	2 (3.70)		

Note: χ^2 or Fisher's exact test for categorical data (Fisher's exact test used when expected cell count <5).

icantly reduced. Williams et al.'s [14] randomized controlled trial also showed that multidisciplinary collaborative nursing improves multiple mental health outcomes, including depression and anxiety, and the effect is consistent across patients of different races, education levels, and income groups, suggesting that this nursing model has broad applicability and promotional value.

The results of this study showed that the ADL score in the observation group increased to 76.70 ± 6.02 points, indicating that the ability of daily living was significantly improved. By analyzing the reasons, multidisciplinary collaborative nursing promoted the recovery of motor function through neurological rehabilitation training, improved emotional state through psychological intervention, and ensured the continuation of rehabilitation effect through persistent nursing guidance. Specifically, the phased rehabilitation plan formulated by rehabilitation therapists was implemented by nurses in daily care; psychological counseling by psychologists and emotional support by nurses complemented each other; dietary guidance by nutritionists improved the general condition of patients, and continuous guidance was provided via telephone follow-up and the WeChat platform after discharge to ensure the continuity of rehabilitation effect. Significant improvements were observed in the psychological, social, and physical dimensions of quality of life, whereas no significant improvement was found in the material dimension—likely because it is primarily influenced by non-medical factors such as economic status and is less responsive to nursing interventions. Srivastava et al. [15] showed that multidisciplinary team nursing has a positive impact on multiple dimensions of patients' quality of life, particularly in emotional support and physical health. Tan et al.'s study [16] also demonstrated that multidisciplinary transitional care intervention can significantly improve the functional status and quality of life of stroke patients.

Cranioplasty complications significantly affect patient prognosis. The observation group's complication rate was markedly lower than the control group, highlighting the value of multidisciplinary collaborative nursing in complication prevention. This is consistent with a study on elderly patients with hip fracture, which revealed that multidisciplinary collaborative nursing reduced pressure ulcers, pulmonary infections, and urinary tract infections while enhancing functional recovery and abilities of daily living. In addition, a study similarly found that in patients with postoperative gastrointestinal tumors, the multidisciplinary collaborative nursing group had a significantly lower complication rate (3.06%) than the control group (8.93%), and the rate of grade A wound healing and treatment compliance was significantly improved [17]. The prospective randomized controlled study on elderly patients with femoral intertrochanteric fracture showed that multidisciplinary team participation in perioperative management could markedly reduce postoperative complication rates, alleviate postoperative pain, improve hip joint function of patients, and shorten fracture healing and hospitalization time [18]. However, although the total complication rate was significantly lower in the observation group, no statistically significant differences were observed in individual complications (flap depression, incision infection, subcutaneous effusion, bone flap resorption and nonunion) when analyzed separately. This is likely due to the relatively small sample size (N = 101), which renders the study underpowered to detect significant differences in low-frequency complications. A post-hoc power analysis in-

dicated that approximately 300–400 patients would be required to detect a 50% relative reduction in a complication with an expected incidence of 10%. Therefore, the lack of statistically significant differences in individual complications should not be interpreted as evidence of no effect, and larger multicenter studies are needed to confirm the impact of multidisciplinary collaborative nursing on specific complications.

The principle underlying our multidisciplinary collaborative nursing model—optimizing perioperative care through team-based intervention—mirrors the current clinical paradigm in other neuro-orthopedic disciplines. For example, in the management of spinal trauma, advanced minimally invasive surgical techniques combined with enhanced recovery after surgery (ERAS) protocols have been shown to accelerate functional recovery, shorten the length of hospital stay, and reduce complication rates [19,20]. These optimized perioperative protocols typically integrate standardized pain management, early mobilization, nutritional support, and psychological counseling—elements that closely parallel the components of our multidisciplinary nursing program for patients undergoing skull defect repair. The parallel success of such team-based, protocol-driven perioperative care across different surgical fields suggests that the benefits of multidisciplinary collaborative care may extend beyond cranioplasty. This broader perspective supports the clinical value of implementing similar collaborative models in other neurosurgical and orthopedic procedures.

This study still has the following limitations: first, as a single-center retrospective study, the sample size is relatively small (101 cases), which may introduce selective bias. Second, the short follow-up period precluded observation of the effect of multidisciplinary collaborative nursing on long-term patient outcomes (e.g., 5-year survival rate and long-term cognitive function). More importantly, this follow-up duration may have been insufficient to capture late-onset complications specific to cranioplasty, such as bone flap resorption and delayed surgical site infections, which can occur many months or even years after surgery. Therefore, the lower complication rate observed in the observation group should be interpreted with caution regarding these delayed complications. Third, a stratified analysis of different subgroups (such as different causes of defects or types of repair materials) was not performed. Fourth, the MMSE is known to be influenced by patients' baseline educational level; however, we did not collect educational background in this retrospective study, which may have confounded the cognitive function results. Fifth, socioeconomic variables such as employment status and return-to-work rates were not collected in this retrospective study, limiting further interpretation of the findings related to the material dimension of quality of life. Future prospective studies should include these variables to better elucidate the determinants of this domain. Sixth, although we used temporal cohorts to reduce selection bias, residual confounders related to temporal changes (e.g., improvements in surgical techniques, anesthesia management, or perioperative care over time) cannot be completely excluded. Prospective randomized controlled trials are needed to confirm these findings. In the future, the applicability of multidisciplinary collaborative nursing in different patient groups should be further explored.

Conclusions

In conclusion, multidisciplinary collaborative nursing markedly enhances the neurological and cognitive function of patients with skull defect repair, effectively relieves anxiety and depression, improves the quality of life and self-care ability in daily life, and reduces the rate of postoperative complications. This nursing model merits clinical use. Future research should further optimize the multidisciplinary collaboration program, establish standardized nursing pathways, and conduct long-term follow-up to evaluate its long-term effects.

Availability of Data and Materials

The data analyzed are available from the corresponding author upon reasonable request.

Author Contributions

YFC and LLY designed the research study. YFC performed the research. LLY analyzed the data. YFC drafted the article. Both authors have been involved in revising the manuscript critically for important intellectual content. Both authors gave final approval of the version to be published. Both authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

The study protocol was approved by the Ethics Committee of The First People's Hospital of Jiashan (2026 Research No. 044). The requirement for informed consent was waived by the Ethics Committee of The First People's Hospital of Jiashan due to the retrospective nature of the study and the anonymous use of patient data, with no additional risk to the participants, and the study adhered to the principles of the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

References

[1] Korhonen TK, Timofeev I, Mee H, Whiting G, Oliver G, Snell B, et al. Outcomes and Workflow in a Titanium Powder Bed Fusion Cranial Reparation Surgery Service. 3D Printing and Additive Manufacturing. 2025; 12: 542–552. https://doi.org/10.1089/3dp.2023.0321

[2] Grant FC, Norcross NC. REPAIR OF CRANIAL DEFECTS BY CRANIOPLASTY. Annals of Surgery. 1939; 110: 488–512. https://doi.org/10.1097/00000658-193910000-00002

[3] Sarov M, Guichard JP, Chibarro S, Guettard E, Godin O, Yelnik A, et al. Sinking skin flap syndrome and paradoxical herniation after hemicraniectomy for malignant hemispheric infarction. Stroke. 2010; 41: 560–562. https://doi.org/10.1161/STROKEAHA.109.568543

[4] Halani SH, Chu JK, Malcolm JG, Rindler RS, Allen JW, Grossberg JA, et al. Effects of Cranioplasty on Cerebral Blood Flow Following Decompressive Craniectomy: A Systematic Review of the Literature. Neurosurgery. 2017; 81: 204–216. https://doi.org/10.1093/neuros/nyx054

[5] Mustafa MA, Richardson GE, Gillespie CS, Clynch AL, Keshwara SM, Gupta S, et al. Health-related quality of life following cranioplasty - a systematic review. British Journal of Neurosurgery. 2025; 39: 12–22. https://doi.org/10.1080/02688697.2023.2202244

[6] Korhonen TK, Mee H, Helmy A, Sule O, Whiting G, Kolias A, et al. Implant-retaining management of cranioplasty-related surgical infections. The Journal of Hospital Infection. 2026; 170: 152–160. https://doi.org/10.1016/j.jhin.2025.04.040

[7] Houskamp EJ, Goel C, Nandoliya KR, Sadagopan NS, Chaliparambil RK, Byrne K, et al. Multidisciplinary Surgical Teams for Cranioplasty: Indications and Outcomes at a Single Institution. The Journal of Craniofacial Surgery. 2025; 36: 1707–1710. https://doi.org/10.1097/SCS.0000000000011149

[8] Ashayeri K, M Jackson E, Huang J, Brem H, Gordon CR. Syndrome of the Trephined: A Systematic Review. Neurosurgery. 2016; 79: 525–534. https://doi.org/10.1227/NEU.0000000000001366

[9] Mustafa MA, Millward CP, Gillespie CS, Richardson GE, Clynch AL, Keshwara SM, et al. Health-related quality of life following cranioplasty: a cross-sectional cohort study - Cranio-PRO. Neurosurgical Review. 2025; 48: 45. https://doi.org/10.1007/s10143-024-03158-6

[10] Crerand CE, Sarwer DB, Kazak AE, Clarke A, Rumsey N. Body Image and Quality of Life in Adolescents With Craniofacial Conditions. The Cleft Palate-craniofacial Journal : Official Publication of the American Cleft Palate-Craniofacial Association. 2017; 54: 2–12. https://doi.org/10.1597/15-167

[11] Aufschnaiter-Hiessboeck KM, Stefanits H, Rossmann T, Aichholzer M, Senker W, Rauch P, et al. Challenging frontiers in neuroplastic cranial reconstruction: addressing neurosurgical wound healing complications through interdisciplinary collaboration - an observational study. Acta Neurochirurgica. 2024; 166: 432. https://doi.org/10.1007/s00701-024-06328-z

[12] Mee H, Anwar F, Timofeev I, Owens N, Grieve K, Whiting G, et al. Cranioplasty: A Multidisciplinary Approach. Frontiers in Surgery. 2022; 9: 864385. https://doi.org/10.3389/fsurg.2022.864385

[13] Yang L, Yan C, Wang J. Effect of multi-disciplinary team care program on quality of life, anxiety, and depression in hepatocellular carcinoma patients after surgery: A randomized, controlled study. Frontiers in Surgery. 2023; 9: 1045003. https://doi.org/10.3389/fsurg.2022.1045003

[14] Williams MK, Shell AL, Wu W, MacDonald KL, Callahan CM, Nurnberger JI, Jr, et al. Longer-term effects of modernized collaborative care for depression on multiple mental health factors (eIMPACT): A randomized controlled trial. Journal of Affective Disorders. 2026; 392: 120272. https://doi.org/10.1016/j.jad.2025.120272

[15] Srivastava A, Daniel E, Lam V, Kwedza RK, Rushton S, Li L. Impact of Multidisciplinary Team Care on Patient-Reported Outcomes in Patients with Lung Cancer: A Systematic Review. Current Oncology (Toronto, Ont.). 2025; 32: 697. https://doi.org/10.3390/curroncol32120697

[16] Tan SYJ, Lee SC, Rusli KDB, Woo BFY, Ang SGM, Zhou W, et al. Effectiveness of Multidisciplinary Transitional Care Interventions on Functional Status, Quality of Life and Readmission Rates in Stroke Patients: A Systematic Review and Meta-Analysis. Journal of Clinical Nursing. 2026; 35: 85–98. https://doi.org/10.1111/jocn.70000

[17] Huang XY, Qian D. Effect of multidisciplinary team collaborative nursing on wound healing and psychological symptoms in postoperative patients with gastrointestinal tumors. World Journal of Gastrointestinal Oncology. 2025; 17: 110471. https://doi.org/10.4251/wjgo.v17.i10.110471

[18] Zhou X, Wei T. Application of multi-disciplinary team nursing model enhances recovery after surgery for total hip arthroplasty and total knee arthroplasty. American Journal of Translational Research. 2024; 16: 3938–3949. https://doi.org/10.62347/BHGS1734

[19] Hey G, Mehkri Y, Mehkri I, Boatright S, Duncan A, Patel K, et al. Enhanced Recovery After Surgery Pathways in Pediatric Spinal Surgery: A Systematic Review and Meta-Analysis. World Neurosurgery. 2024; 190: 329–338. https://doi.org/10.1016/j.wneu.2024.07.170

[20] Debono B, Wainwright TW, Wang MY, Sigmundsson FG, Yang MMH, Smid-Nanninga H, et al. Consensus statement for perioperative care in lumbar spinal fusion: Enhanced Recovery After Surgery (ERAS®) Society recommendations. The Spine Journal : Official Journal of the North American Spine Society. 2021; 21: 729–752. https://doi.org/10.1016/j.spinee.2021.01.001