



OUTCOME E COMPLICANZE DEL TRATTAMENTO CHIRURGICO DELLA MALFORMAZIONE DI CHIARI

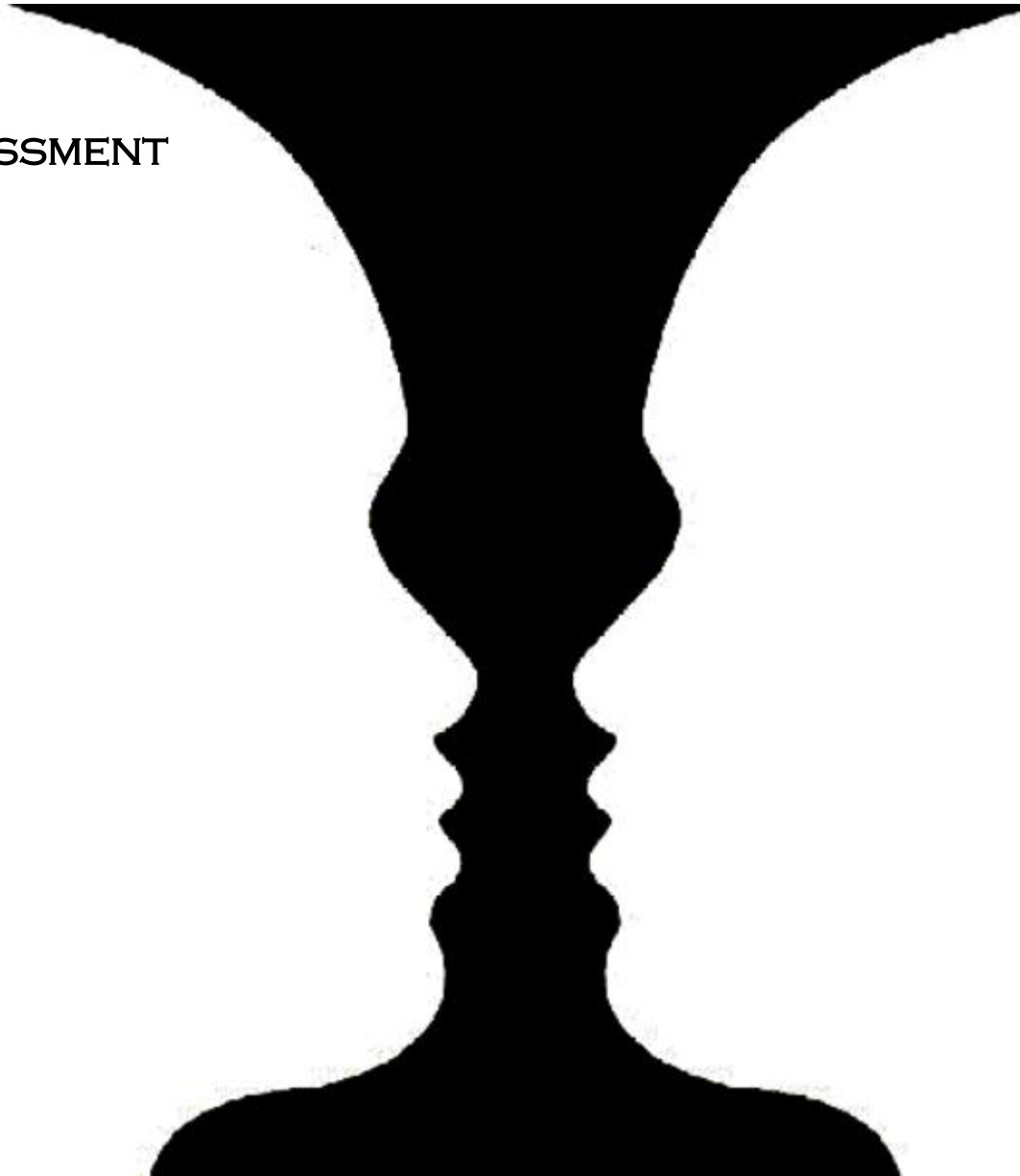
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OUTCOME DEL TRATTAMENTO
CHIRURGICO DELLA MALFORMAZIONE DI
CHIARI

GESTALT ASSESSMENT



A Novel Scoring System for Assessing Chiari Malformation Type I Treatment Outcomes

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BACKGROUND: Outcome assessment for the management of Chiari malformation type 1 is difficult because of the lack of a reliable and specific surgical outcome assessment scale. Such a scale could reliably correlate postoperative outcomes with preoperative symptoms.

OBJECTIVE: We developed a novel scoring system and applied it retrospectively to 146 patients treated at our institution in order to create and verify a simple and quantifiable assessment of Chiari outcomes.

METHODS: The Chicago Chiari Outcome Scale (CCOS) uses 4 postoperative outcome categories (pain, nonpain symptoms, functionality, and complications) graded 1 to 4 for a total possible score of 16. As a comparison with current Chiari outcome methodology, each patient was also placed into a gestalt outcome group of "improved," "unchanged," or "worse" (I/U/W). Patients were stratified by CCOS scores and by I/U/W group.

RESULTS: Stratifying patients by total CCOS scores showed that patients who achieved CCOS scores between 13 and 16 were predominantly in the I/U/W improved group ($n = 101$, 69%); scores between 9 and 12 were predominantly I/U/W unchanged ($n = 39$, 27%), and scores between 4 and 8 were I/U/W worse ($n = 6$, 4%). Symptom subscore results provided insight into the specifics of the overall outcome in addition to the more quantitative nature of the 16-point scale.

CONCLUSION: We describe a CCOS that assigns higher scores to patients judged improved by gestalt I/U/W ratings and lower scores to those who were unchanged or worse while defining outcome in 4 specific subcategories. As such, this CCOS should allow for a more unified and quantifiable outcome assessment after Chiari surgery.

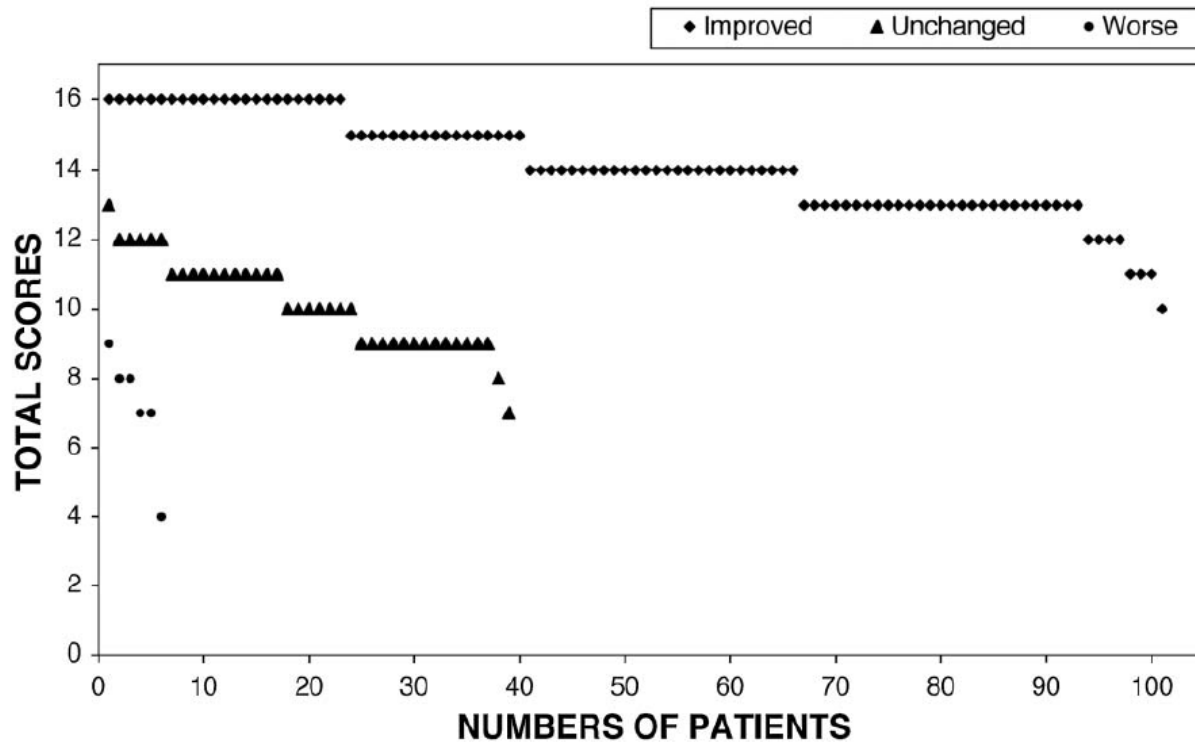
KEY WORDS: Chiari malformation type 1, Outcome assessment, Posterior fossa decompression, Scoring system

Chicago Chiari Outcome Scale

<u>Pain</u>	<u>Non-pain</u>	<u>Functionality</u>	<u>Complications</u>	<u>Total Score</u>
1 - Worse	1 - Worse	1 - Unable to attend	1 - Persistent complication, poorly controlled	4 - Incapacitated outcome
2 - Unchanged and refractory to medication	2 - Unchanged or improved but impaired	2 - Moderate impairment (<50% attendance)	2 - Persistent complication, well controlled	8 - Impaired outcome
3 - Improved or controlled with medication	3 - Improved and unimpaired	3 - Mild impairment (>50% attendance)	3 - Transient complication	12 - Functional outcome
4 - Resolved	4 - Resolved	4 - Fully functional	4 - Uncomplicated course	16 - Excellent outcome

FIGURE 1. *The Chicago Chiari Outcome Scale.*

OUTCOME SCORES FOR 146 PATIENTS



RESULTS: Stratifying patients by total CCOS scores showed that patients who achieved CCOS scores between 13 and 16 were predominantly in the I/U/W improved group (n = 101, 69%); scores between 9 and 12 were predominantly I/U/W unchanged (n = 39, 27%), and scores between 4 and 8 were I/U/W worse (n = 6, 4%). Symptom subscore results provided insight into the specifics of the overall outcome in addition to the more quantitative nature of the 16-point scale.

External validation of the Chicago Chiari Outcome Scale

Clinical article

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Object. Historically, assessment of clinical outcomes following surgical management of Chiari malformation Type I (CM-I) has been challenging due to the lack of a validated instrument for widespread use. The Chicago Chiari Outcome Scale (CCOS) is a novel system intended to provide a less subjective evaluation of outcomes for patients with CM-I. The goal of this study was to externally validate the performance of the CCOS.

Methods. Patients undergoing surgery for CM-I between 2001 and 2012 were reviewed ($n = 292$). Inclusion criteria for this study were as follows: 1) patients receiving primary posterior fossa decompression; 2) at least 5.5 months of postoperative clinical follow-up; and 3) patients ≤ 18 years of age at the time of surgery. Outcomes were evaluated using the CCOS, along with a "gestalt" impression of whether patients experienced significant improvement after surgery. A subgroup of 118 consecutive patients undergoing operations between 2008 and 2010 was selected for analysis of interrater reliability ($n = 73$ meeting inclusion/exclusion criteria). In this subgroup, gestalt and CCOS scores were independently determined by 2 reviewers, and interrater reliability was assessed using the intraclass correlation coefficient (ICC) and kappa (κ) statistic.

Results. The median CCOS score was 14, and 67% of patients had improved gestalt scores after surgery. Overall, the CCOS was effective at identifying patients with improved outcome after surgery (area under curve = 0.951). The interrater reliability of the CCOS (ICC = 0.71) was high, although the reliability of the component scores ranged from poor to good (ICC 0.23–0.89). The functionality subscore demonstrated a low ICC and did not add to the predictive ability of the logistic regression model (likelihood ratio = 1.8, $p = 0.18$). When analyzing gestalt outcome, there was moderate agreement between raters ($\kappa = 0.56$).

Conclusions. In this external validation study, the CCOS was effective at identifying patients with improved outcomes and proved more reliable than the authors' gestalt impression of outcome. However, certain component subscores (functionality and nonpain symptoms) were found to be less reliable, and may benefit from further definition in score assignment. In particular, the functionality subscore does not add to the predictive ability of the CCOS, and may be unnecessary. Overall, the authors found the CCOS to be an improvement over the previously used assessment of outcome at their institution.

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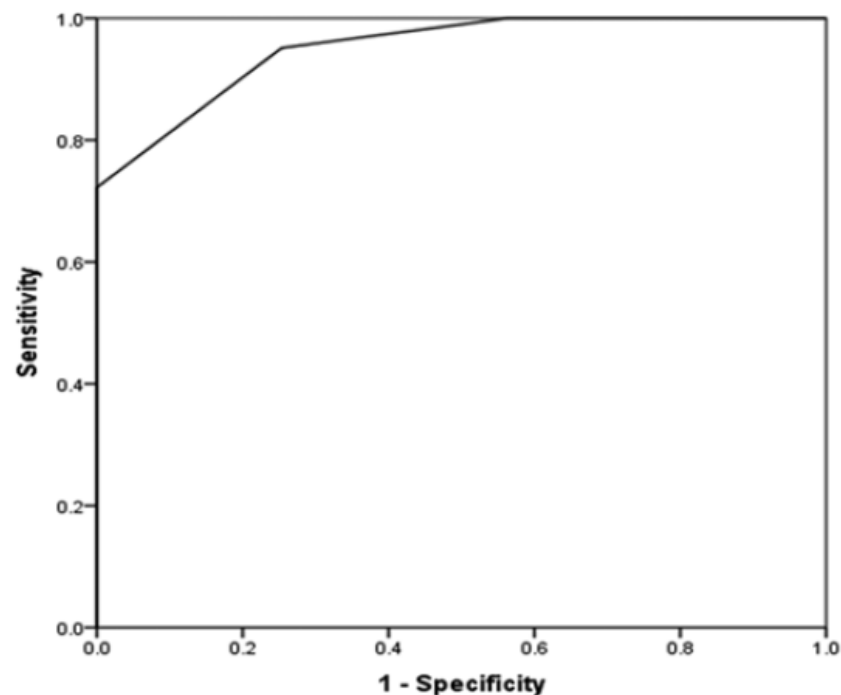
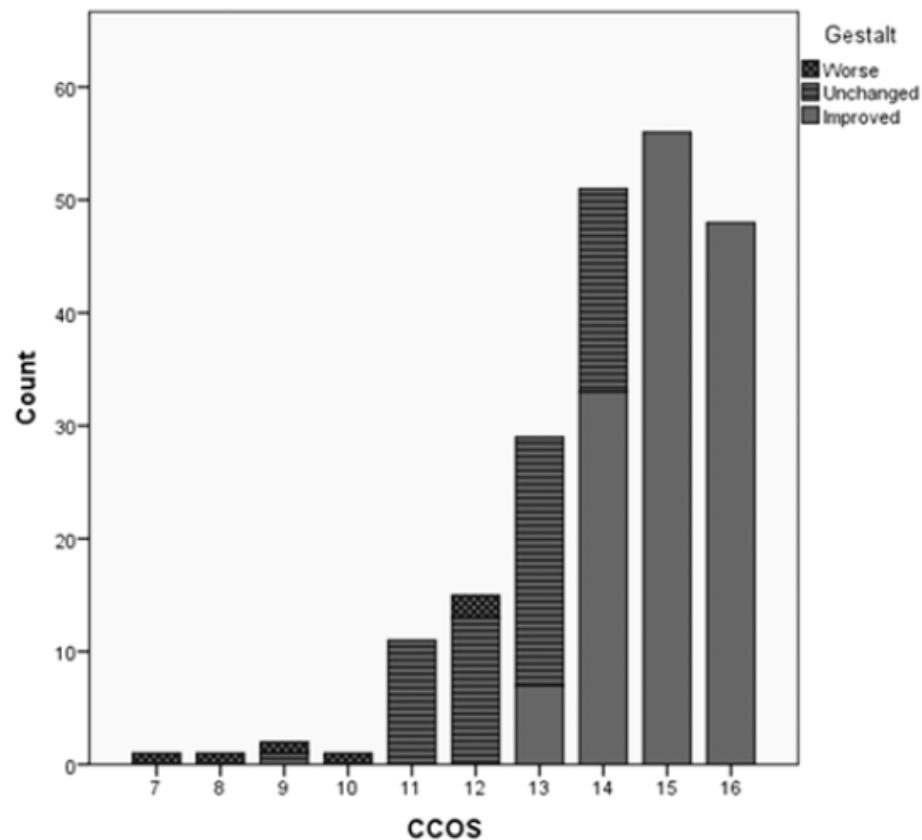


TABLE 2: Demographic and outcome characteristics in 215 patients with CM-I decompression*

Characteristic	Value
mean age in yrs $\pm$ SD (range)	10 $\pm$ 5.1 (0.5–18.7)
no. of females (%)	126 (59)
mean postop follow-up in mos $\pm$ SD (range)	37 $\pm$ 29 (5.7–142)
median CCOS score (range)	14 (7–16)
no. w/ improved gestalt outcome (%)	144 (67)

TABLE 4: Logistic regression of CCOS subscores*

Variable	B (SE)	OR (95% CI)
complications	2.0 (0.5)	7.3 (2.9–18.7)
pain	3.9 (0.7)	47.2 (12.3–180.6)
nonpain symptoms	3.8 (0.7)	43.4 (11.7–160.3)
functionality	1.2 (1.0)	3.2 (0.5–22.4)

* Nagelkerke $R^2 = 0.81$. Higher subscores for complications, pain, and nonpain symptoms were associated with improved gestalt outcome. B = beta statistic.

TABLE 5: Interclass coefficients of CCOS and subscores*

Measure	ICC†
CCOS score	0.71
CCOS subscore	
complications	0.89
pain	0.63
nonpain symptoms	0.58
functionality	0.23

* The ICC was calculated for total score and for all component measures. Moderate to excellent agreement was noted in all except the functionality subscore. After reviewing areas of disagreement, the authors noted that interpretation of both the CCOS system and patient records probably affected this subscore more than others.

† An ICC > 0.7 is reliable, by certain conventions.

External validation of the Chicago Chiari Outcome Scale in adults with Chiari malformation type I

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OBJECTIVE The Chicago Chiari Outcome Scale (CCOS) serves as a standardized clinical outcome evaluation tool among patients with Chiari malformation type I (CM-I). While the reliability of this scale has been proven for pediatric patients, the literature lacks CCOS validation when used solely in adults. Therefore, this study aimed to determine the validity of the CCOS in an external cohort of adult patients.

METHODS The authors retrospectively analyzed the medical records of symptomatic patients with CM-I who underwent posterior fossa decompression between 2010 and 2018 in six neurosurgical departments. Each patient was clinically assessed at the latest available follow-up. Gestalt outcome was determined as improved, unchanged, or worsened compared with the preoperative clinical state. Additionally, the CCOS score was calculated for each patient based on the detailed clinical data. To verify the ability of the CCOS to determine clinical improvement, the area under the receiver operating characteristic (AUROC) curve was evaluated. A logistic regression analysis using all four components of the CCOS (pain symptoms, nonpain symptoms, functionality, and complications) was performed to establish predictors of the improved outcome.

RESULTS Seventy-five individuals with a mean age of 42 ± 15.32 years were included in the study. The mean follow-up duration was 52 ± 33.83 months. Considering gestalt outcome evaluation, 41 patients (54.7%) were classified as improved, 24 (32%) as unchanged, and 10 (13.3%) as worsened. All patients with a CCOS score of 14 or higher improved, while all those with a CCOS score of 8 or lower worsened. The AUROC was 0.986, suggesting almost perfect accuracy of the CCOS in delineating clinical improvement. A CCOS score of 13 showed high sensitivity (0.93) and specificity (0.97) for identifying patients with clinical improvement. Additionally, a meaningful correlation was found between higher CCOS scores in each component and better outcomes. Patient stratification by total CCOS score showed that those categorized as improved, unchanged, and worsened scored prevalently between 13 and 16 points, 10 and 12 points, and 4 and 9 points, respectively.

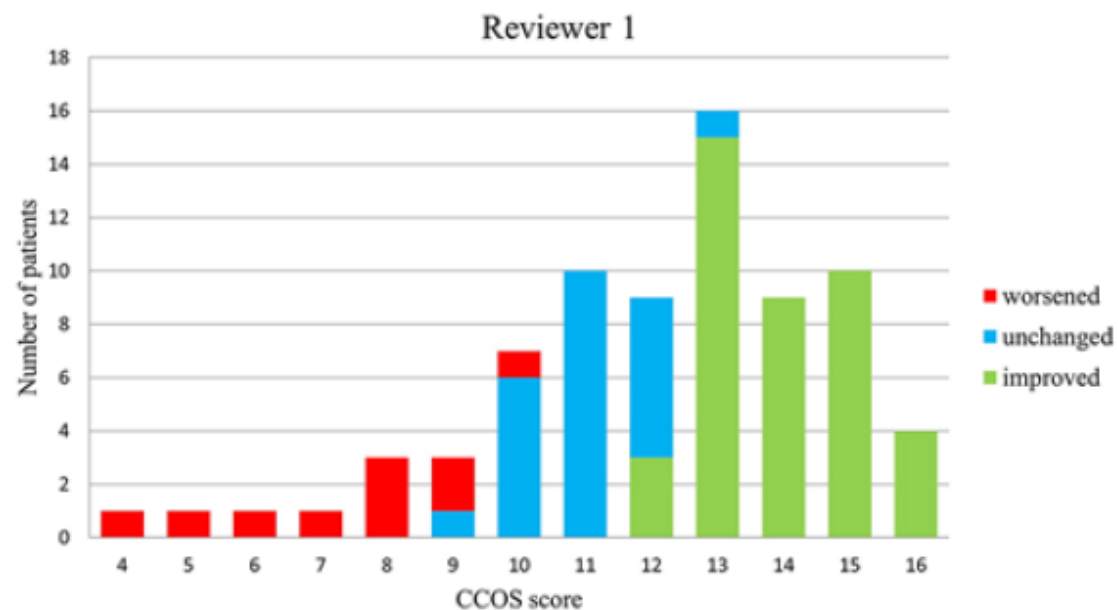


TABLE 1. Patient characteristics

Feature	Value
Sex, n (%)	
Female	55 (73.3)
Male	20 (26.7)
Mean age (range), yrs	42 (18–60)
Symptoms, n (%)	
Headaches	54 (72)
Vertigo	38 (50.7)
Nausea/vomiting	15 (20)
Nystagmus	7 (9.3)
Tinnitus	4 (5.3)
Brainstem signs	14 (18.7)
Cerebellar signs	24 (32)
Myelopathic symptoms	46 (61.3)
Peripheral neuropathy symptoms	29 (38.7)
Sensory disturbances in extremities	48 (64)
Motor disturbances in extremities	23 (30.7)
Syringomyelia	41 (54.7)
Scoliosis	4 (5.3)
Surgery, n (%)	
PFD	14 (18.7)
PFDD	52 (69.3)
PFDRT	9 (12)
Complications	9 (12)
Pseudomeningocele	4 (5.3)
CSF leakage	2 (2.7)
Fever	2 (2.7)
Wound dehiscence	1 (1.3)
Revision surgery	7 (9.3)

PFDD = PFD with duraplasty; PFDRT = PFD with resection of the tonsils.

TABLE 4. Logistic regression analysis of CCOS components to reflect the likelihood of clinical improvement

CCOS Component	B	OR (95% CI)
Pain symptoms	2.07	7.99 (3.19–20.01)
Nonpain symptoms	3.05	21.12 (5.91–75.41)
Functionality	1.87	6.53 (2.76–15.51)
Complications	0.64	1.91 (0.91–3.98)

B = beta statistic.

TABLE 2. Characteristics of CCOS scores with the corresponding ICC

CCOS Component	Median (range)	ICC
Total score	13 (4–16)	0.99
Pain symptoms	3 (1–4)	0.99
Nonpain symptoms	3 (1–4)	0.98
Functionality	3 (1–4)	0.99
Complications	4 (1–4)	0.98



Clinical outcome of different surgical approaches for symptomatic Chiari malformation without syringomyelia: a 13-year retrospective study

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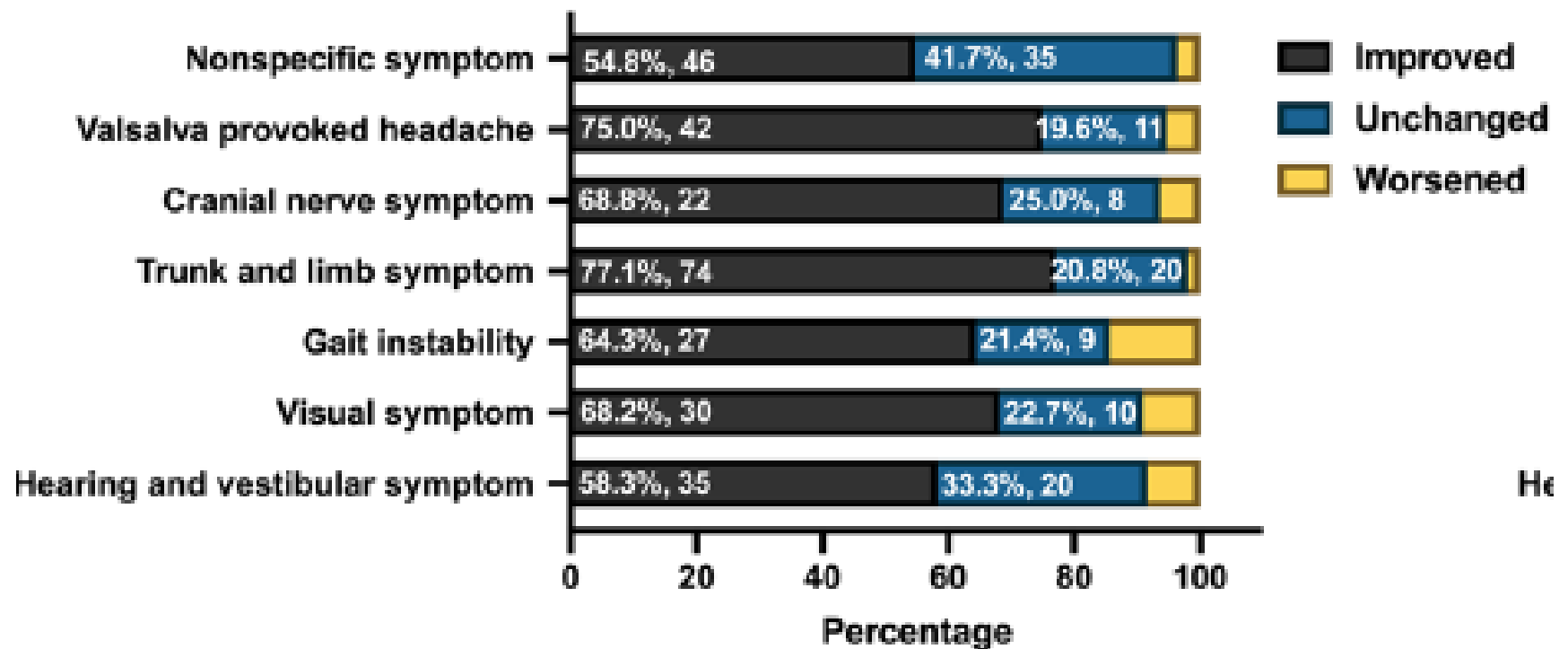
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Abstract

Chiari malformation, a condition that disrupts cerebrospinal fluid circulation. While previous studies have extensively explored the symptoms, treatment approaches, and clinical outcomes for patients with Chiari malformation accompanied by syringomyelia, there is limited research focused on those without syringomyelia. This study aims to evaluate the symptoms, treatments, intradural findings, and clinical outcomes in patients with Chiari malformation without syringomyelia. This single-center, retrospective study analyzed 148 patients diagnosed with Chiari malformation without syringomyelia between January 2010 and September 2022. Patients underwent one of two surgical approaches: posterior fossa decompression (PFD) or posterior fossa decompression with duraplasty (PFDD). Data on clinical symptoms, intradural findings, surgical outcomes, and postoperative complications were collected and analyzed. A total of 148 patients were included in the study, with 30 undergoing PFD and 118 receiving PFDD. Patients treated with PFDD showed significantly improved CCOS scores compared to those treated with PFD (12.8 ± 1.9 vs. 11.8 ± 2.5 , $P=0.018$). Symptom improvement rates were comparable between the two groups. Among PFDD patients, over 80% exhibited intradural abnormalities, with 28.4% classified as severe. Severe intradural abnormalities were strongly associated with higher rates of Valsalva-provoked pain (59.5% vs. 26.3%, $P<0.001$). PFDD significantly improves CCOS scores compared to PFD, highlighting its potential as a more effective surgical approach for Chiari malformation without syringomyelia.

Clinical trial number Not applicable.

Keywords Chiari malformation · Syringomyelia · Posterior fossa decompression · Duraplasty · Clinical outcomes



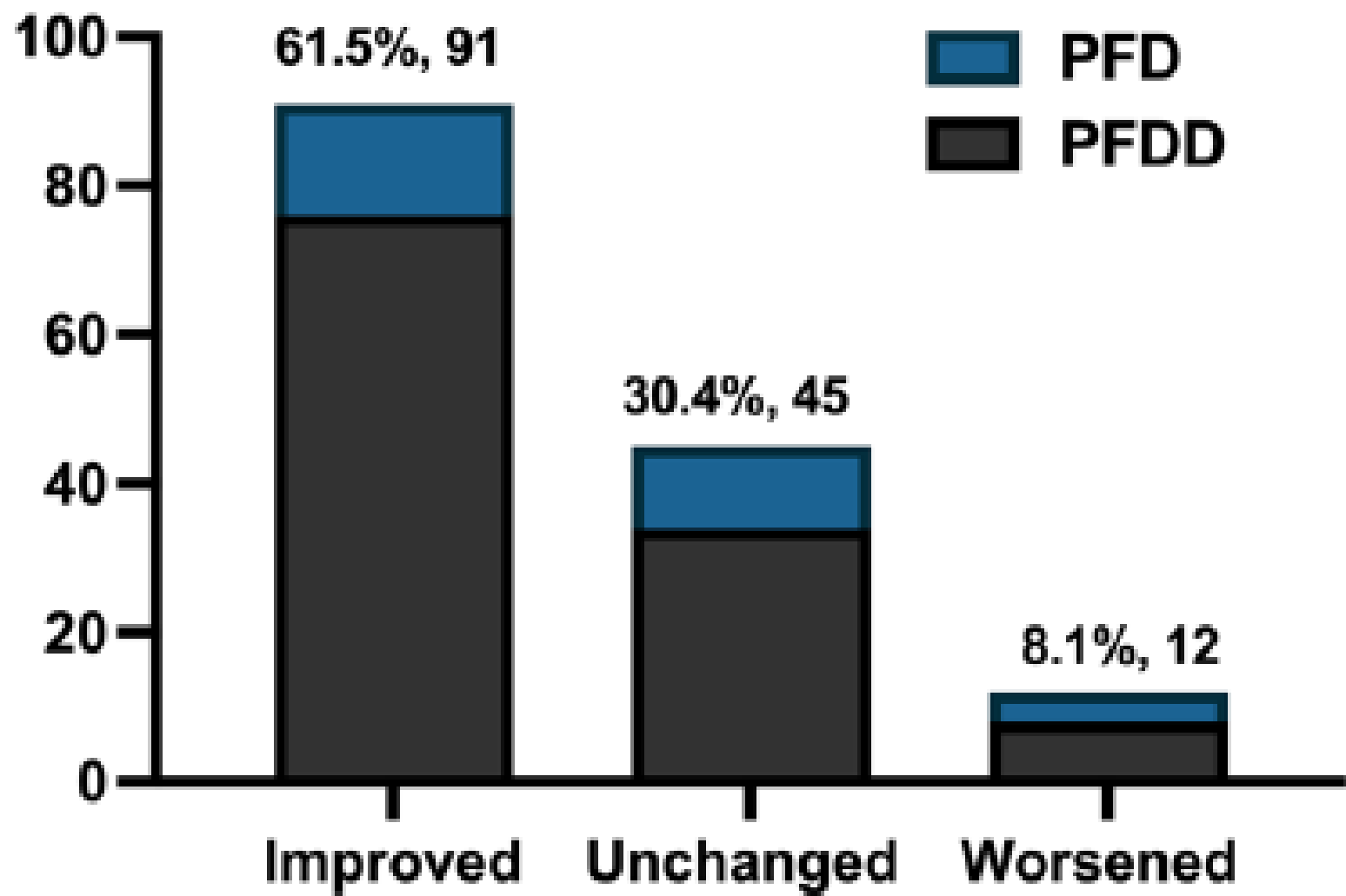


Table 1 Demographic and clinical characteristics of Chiari malformation without Syringomyelia

Variable	ALL (%)	PFD (%)	PFDD (%)	P-value
Number of patients	148(100)	30(100)	118(100)	
Sex				0.452
Male	32(21.6)	8(26.7)	24(20.3)	
Female	116(78.4)	22(73.3)	94(79.7)	
Age (yrs)				0.116
Mean±SD	45.9±12.6	49.1±17.3	45.0±11.0	
Range	13–77	13–77	16–62	
BMI				0.029*
Mean±SD	24.1±3.4	22.9±3.3	24.4±3.4	
Range	14.8–39.7	14.8–28.8	18.1–39.7	
Descent of cerebellar tonsils (mm)				0.398
Mean±SD	11.9±4.3	11.3±3.9	12.1±4.5	
Range	6–23	8–15	6–23	
Intradural lesion grade				-
Grade 0	16(10.8)	-	16(13.6)	
Grade 1	60(40.5)	-	60(50.8)	
Grade 2	42(28.4)	-	42(35.6)	
Decompression area (cm ²)				0.195
<3×3	94(63.5)	16(53.3)	78(66.1)	
≥3×3	54(36.5)	14(46.7)	40(33.9)	
Duraplasty material				-
Artificial dura	24(16.2)	-	24(20.3)	
Autologous	94(63.5)	-	94(79.7)	
fascia				
CCOS				0.018*
Mean±SD	12.6±2.1	11.8±2.5	12.8±1.9	
Range	8–16	8–16	8–16	
Complications				0.413
Fever	10(6.8)	1(3.3)	9(7.6)	
Infection	3(2.0)	1(3.3)	2(1.7)	
Cerebrospinal fluid leak	3(2.0)	0	3(2.5)	
Re-operation				
N	6(4.1)	3(10.0)	3(2.5)	0.064
Time of re-operation (yrs)	3.9±1.5	4.4±1.8	3.4±1.0	0.540

SD: standard deviation; BMI: body mass index; N: number; *, indicates a statistically significant difference

Surgical Treatment of Chiari I Malformation—Analysis of Intraoperative Findings, Complications, and Outcome for 371 Foramen Magnum Decompressions

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BACKGROUND: Foramen magnum decompression is widely accepted as the treatment of choice for Chiari I malformation. However, important surgical details of the procedure are controversial.

OBJECTIVE: This study analyzes 371 decompressions focusing on intraoperative findings, analysis of complications, and long-term outcomes.

METHODS: Among 644 patients between 1985 and 2010, 359 patients underwent 371 decompressions. Surgery for symptomatic patients consisted of suboccipital craniectomy, C1 laminectomy, arachnoid dissection, and duraplasty. Short-term results were determined after 3 months; long-term outcomes were evaluated with Kaplan-Meier statistics.

RESULTS: The mean age was 40 ± 16 years; mean follow-up was 49 ± 56 months; 75.8% demonstrated syringomyelia. The complication rate was 21.8% with permanent surgical morbidity of 3.2% and surgical mortality of 1.3%. Of the patients, 73.6% reported improvement after 3 months; 21% were unchanged. Overall, 14.3% demonstrated a neurological deterioration within 5 years and 15.4% within 10 years. The severity of neurological symptoms correlated with the grade of arachnoid pathology. Outcome data correlated with the number of previous decompressions, severity of arachnoid pathology, handling of the arachnoid, type of duraplasty, and surgical experience. First-time decompressions with arachnoid dissection and an alloplastic duraplasty resulted in surgical morbidity for 2.0%, a 0.9% mortality rate, postoperative improvement after 3 months for 82%, and neurological recurrence rates of 7% after 5 years and 8.7% after 10 years.

CONCLUSION: Arachnoid pathology in Chiari I malformation has an impact on clinical symptoms and postoperative results. Decompressions with arachnoid dissection and an alloplastic duraplasty performed by surgeons experienced with this pathology offer a favorable long-term prognosis.

KEY WORDS: Arachnoiditis, Basilar invagination, Syringomyelia

TABLE 7. Neurological Scores in the First Postoperative Year as Defined in Table 1^a

Symptom	First Surgery	Revision Surgery	Children	Adults	Arach. Grade 0	Arach. Grade 1	Arach. Grade 2	All
Hypesthesia								
Preoperatively	3.7 ± 1.0	3.3 ± 1.0	4.2 ± 0.9	3.6 ± 1.0	4.1 ± 1.0	3.6 ± 0.9	3.3 ± 0.9	3.6 ± 1.0
Postoperatively	3.8 ± 0.9	3.3 ± 1.1	4.3 ± 0.8	3.7 ± 0.9	4.3 ± 0.8	3.8 ± 0.9	3.3 ± 1.0	3.8 ± 1.0
3 months	4.0 ± 0.9	3.4 ± 1.0	4.5 ± 0.7	3.8 ± 0.9	4.4 ± 0.8	3.9 ± 0.8	3.4 ± 1.0	3.9 ± 0.9
1 year	4.0 ± 0.9	3.4 ± 1.0	4.6 ± 0.6	3.9 ± 0.9	4.5 ± 0.7	4.0 ± 0.8	3.4 ± 1.0	4.0 ± 0.9
Dysesthesia								
Preoperatively	4.1 ± 0.9	4.2 ± 0.9	4.4 ± 1.0	4.1 ± 0.9	4.4 ± 0.8	4.1 ± 1.0	4.3 ± 1.0	4.1 ± 0.9
Postoperatively	4.3 ± 0.8	4.3 ± 0.8	4.5 ± 0.9	4.3 ± 0.8	4.6 ± 0.7	4.3 ± 0.9	4.3 ± 0.9	4.3 ± 0.8
3 months	4.4 ± 0.8	4.3 ± 0.8	4.6 ± 0.8	4.3 ± 0.8	4.6 ± 0.6	4.3 ± 0.8	4.3 ± 0.9	4.4 ± 0.8
1 year	4.4 ± 0.8	4.3 ± 0.8	4.7 ± 0.8	4.3 ± 0.8	4.6 ± 0.6	4.3 ± 0.8	4.4 ± 0.8	4.4 ± 0.8
Pain								
Preoperatively	3.6 ± 0.9	3.7 ± 1.0	3.6 ± 0.8	3.5 ± 0.9	3.4 ± 0.9	3.5 ± 0.8	3.7 ± 0.9	3.5 ± 0.9
Postoperatively	4.1 ± 0.7	3.9 ± 0.8	4.0 ± 0.7	4.0 ± 0.7	4.0 ± 0.7	4.0 ± 0.6	4.1 ± 0.8	4.0 ± 0.7
3 months	4.3 ± 0.7	4.1 ± 0.9	4.3 ± 0.7	4.3 ± 0.7	4.4 ± 0.7	4.3 ± 0.7	4.2 ± 0.8	4.3 ± 0.7
1 year	4.4 ± 0.7	4.1 ± 0.9	4.6 ± 0.7	4.3 ± 0.7	4.4 ± 0.8	4.3 ± 0.7	4.2 ± 0.8	4.3 ± 0.8
Motor weakness								
Preoperatively	4.4 ± 0.9	3.6 ± 1.1	4.5 ± 0.7	4.3 ± 1.0	4.7 ± 0.6	4.5 ± 0.8	3.5 ± 1.1	
Postoperatively	4.5 ± 0.8	3.6 ± 1.0	4.6 ± 0.7	4.4 ± 0.9	4.8 ± 0.6	4.6 ± 0.7	3.5 ± 1.1	4.4 ± 0.9
3 months	4.6 ± 0.8	3.7 ± 1.0	4.7 ± 0.6	4.4 ± 0.9	4.8 ± 0.6	4.6 ± 0.7	3.6 ± 1.1	4.5 ± 0.9
1 year	4.6 ± 0.8	3.7 ± 1.0	4.8 ± 0.6	4.4 ± 0.9	4.8 ± 0.6	4.6 ± 0.7	3.5 ± 1.1	4.5 ± 0.9
Gait ataxia								
Preoperatively	4.1 ± 0.9	3.3 ± 1.3	4.2 ± 1.0	4.1 ± 0.9	4.2 ± 0.9	4.2 ± 0.8	3.6 ± 1.1	4.1 ± 0.9
Postoperatively	4.2 ± 0.9	3.3 ± 1.3	4.2 ± 0.9	4.2 ± 0.9	4.3 ± 0.8	4.3 ± 0.7	3.6 ± 1.1	4.2 ± 0.9
3 months	4.4 ± 0.9	3.5 ± 1.4	4.5 ± 0.9	4.3 ± 0.9	4.5 ± 0.8	4.5 ± 0.7	3.8 ± 1.1	4.3 ± 0.9
1 year	4.5 ± 0.8	3.5 ± 1.4	4.7 ± 0.7	4.4 ± 0.9	4.6 ± 0.8	4.6 ± 0.7	3.8 ± 1.1	4.4 ± 0.9
Bladder function								
Preoperatively	4.8 ± 0.6	4.3 ± 1.5	4.9 ± 0.3	4.8 ± 0.6	4.9 ± 0.6	4.9 ± 0.5	4.7 ± 0.7	4.7 ± 0.7
Postoperatively	4.8 ± 0.6	4.4 ± 1.3	4.8 ± 0.7	4.8 ± 0.5	4.9 ± 0.6	4.9 ± 0.3	4.7 ± 0.7	4.7 ± 0.6
3 months	4.8 ± 0.5	4.4 ± 1.3	4.9 ± 0.2	4.8 ± 0.5	4.9 ± 0.6	4.9 ± 0.4	4.7 ± 0.6	4.8 ± 0.5
1 year	4.8 ± 0.5	4.4 ± 1.3	4.9 ± 0.2	4.8 ± 0.5	4.9 ± 0.6	4.9 ± 0.3	4.6 ± 0.8	4.8 ± 0.5
Swallowing								
Preoperatively	4.7 ± 0.7	4.6 ± 0.7	4.7 ± 0.7	4.7 ± 0.6	4.8 ± 0.6	4.8 ± 0.5	4.6 ± 0.8	4.7 ± 0.7
Postoperatively	4.8 ± 0.5	4.7 ± 0.6	4.7 ± 0.7	4.8 ± 0.5	4.8 ± 0.6	4.9 ± 0.3	4.7 ± 0.7	4.8 ± 0.5
3 months	4.8 ± 0.4	4.6 ± 0.7	4.8 ± 0.5	4.8 ± 0.4	4.9 ± 0.3	4.9 ± 0.3	4.7 ± 0.7	4.8 ± 0.5
1 year	4.9 ± 0.4	4.6 ± 0.6	4.8 ± 0.5	4.8 ± 0.4	5.0 ± 0.2	4.9 ± 0.3	4.7 ± 0.6	4.8 ± 0.5
Overall								
Better	76.3%	65.1%	64.3%	78.3%	82.5%	84.5%	58.5%	73.6%
Unchanged	19.7%	23.3%	32.1%	17.9%	17.5%	12.6%	26.8%	21.0%
Worse	4.0%	11.6%	3.6%	3.9%	-	2.9%	14.6%	5.5%

^aArach., arachnopathy.

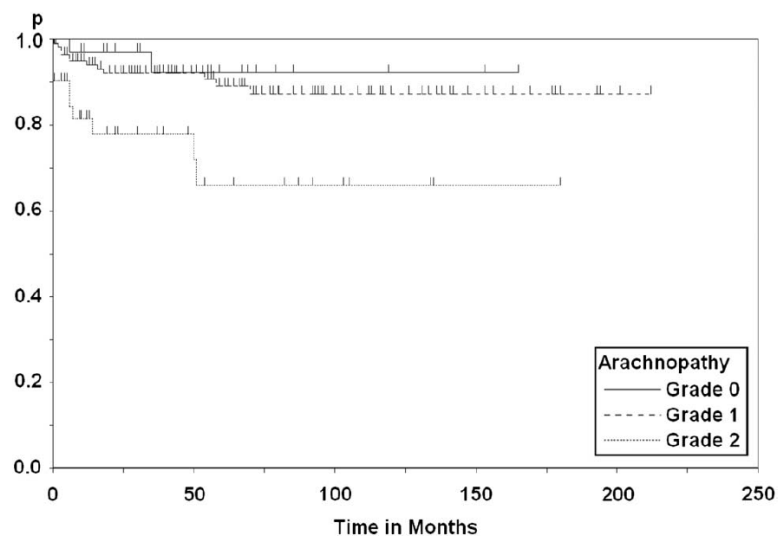


FIGURE 4. Rates of patients without neurological deterioration after decompression of the foramen magnum according to grades of arachnopathy as a function of time (log-rank test: $P = .003$).

TABLE 9. Risk Factors of a Neurological Recurrence^a

Factor	β -Value
Arachnoid pathology	.135
Less experienced surgeon	.093
Arachnoid not opened	.081
Age	.065
Basilar invagination	.058

^aExplanation: multiple regression analysis ($P = .017$) with β -values to indicate the impact of individual factors.

Neurological deterioration after foramen magnum decompression for Chiari malformation Type I: old or new pathology?

Clinical article

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Object. Decompression of the foramen magnum is widely accepted as the procedure of choice for patients with Chiari malformation Type I (CM-I). This study was undertaken to determine the mechanisms responsible for neurological deterioration after foramen magnum decompression and the results of secondary interventions.

Methods. Between 1987 and 2010, 559 patients with CM-I presented, 107 of whom had already undergone a foramen magnum decompression, which included a syrinx shunt in 27 patients. Forty patients who were neurologically stable did not undergo another operation. Sixty-seven patients with progressive symptoms received a recommendation for surgery, which was refused by 16 patients, while 51 patients underwent a total of 61 secondary operations. Hospital and outpatient records, radiographic studies, and intraoperative images were analyzed. Additional follow-up information was obtained by telephone calls and questionnaires. Short-term results were determined after 3 and 12 months, and long-term outcomes were evaluated using Kaplan-Meier statistics.

Results. Sixty-one secondary operations were performed after a foramen magnum decompression. Of these 61 operations, 15 involved spinal pathologies not related to the foramen magnum (spinal group), while 46 operations were required for a foramen magnum issue (foramen magnum group). Except for occipital pain and swallowing disturbances, the clinical course was comparable in both groups. In the spinal group, 5 syrinx shunt catheters were removed because of nerve root irritations or spinal cord tethering. Eight patients underwent a total of 10 operations on their cervical spine for radiculopathies or a myelopathy. No permanent surgical morbidity occurred in this group. In the foramen magnum group, 1 patient required a ventriculoperitoneal shunt for hydrocephalus 7 months after decompression. The remaining 45 secondary interventions were foramen magnum revisions, of which 10 were combined with craniocervical fusion. Intraoperatively, arachnoid scarring with obstruction of the foramen of Magendie was the most common finding. Complication rates for foramen magnum revisions were similar to first decompressions, whereas permanent surgical morbidity was higher at 8.9%. Postoperative clinical improvements were marginal in both surgical groups. With the exception of 1 patient who underwent syrinx catheter removal and had a history of postoperative meningitis, all patients in the spinal group were able to be stabilized neurologically. Long-term results in the foramen magnum group revealed clinical stabilizations in 66% for at least 5 years.

Conclusions. Neurological deterioration in patients after a foramen magnum decompression for CM-I may be related to new spinal pathologies, craniocervical instability, or recurrent CSF flow obstruction at the foramen magnum. Whereas surgery for spinal pathologies is regularly followed by clinical stabilization, the rate of long-term success for foramen magnum revisions was limited to 66% for 5 years due to severe arachnoid scarring in a significant proportion of these patients. Therefore, foramen magnum revisions should be restricted to patients with progressive symptoms.

(<http://thejns.org/doi/abs/10.3171/2012.9.PEDS12110>)

KEY WORDS • syringomyelia • arachnoiditis • basilar invagination • degenerative disc disease • craniocervical instability • Chiari malformation

TABLE 5: Pathological findings of 45 foramen magnum revisions

Feature	No. of Ops*
pseudomeningocele	8
adhesion of graft to cerebellum	24
adhesion of graft to spinal cord	5
slight arachnoid scarring	7
severe arachnoid scarring	24
history of meningitis	3
obstruction of foramen of Magendie	20
ventricular dilatation	7
anterior compression by odontoid	1
craniocervical instability	10

* Multiple features may be found in a single operation; thus, the sum total is higher than the number of revisions.

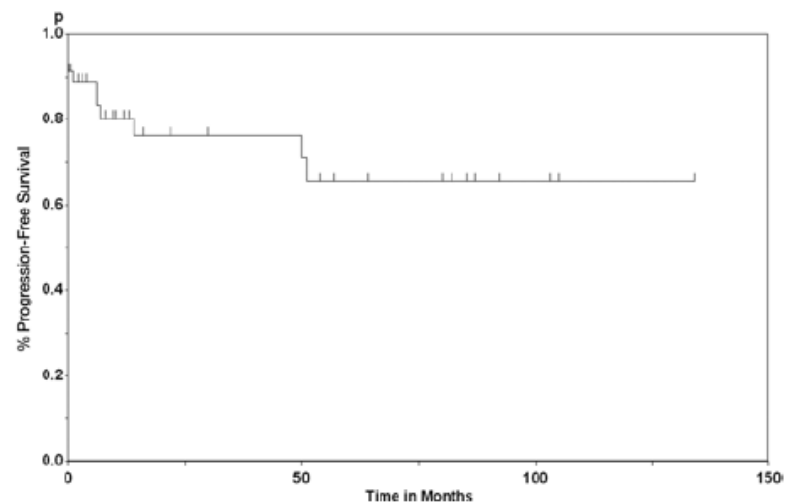
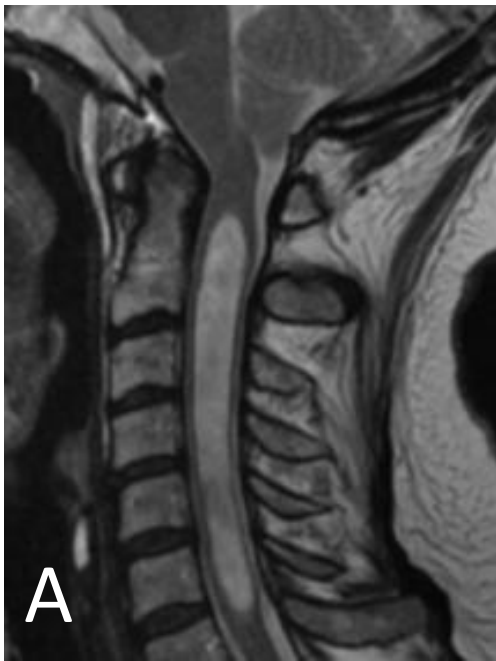


FIG. 5. Kaplan-Meier analysis of progression-free survival for patients undergoing a foramen magnum revision with or without additional fusion.

Donna di 56 anni . Presentazione clinica con acufeni persistenti .



Comparison of Results Between Posterior Fossa Decompression with and without Duraplasty for the Surgical Treatment of Chiari Malformation Type I: A Systematic Review and Meta-Analysis

Weiwei Lin¹, Guman Duan², Jinjin Xie³, Jiashen Shao², Zhaoqi Wang¹, Baohua Jiao¹

Key words

- Chiari malformation (CM-1)
- Duraplasty
- Meta-analysis
- Posterior fossa decompression
- Systematic review

Abbreviations and Acronyms

CI: Confidence interval

CM-1: Chiari malformation type I

CSF: Cerebrospinal fluid

MRI: Magnetic resonance imaging

PFD: Posterior fossa decompression

PFDD: Posterior fossa decompression with duraplasty

RR: Relative risk

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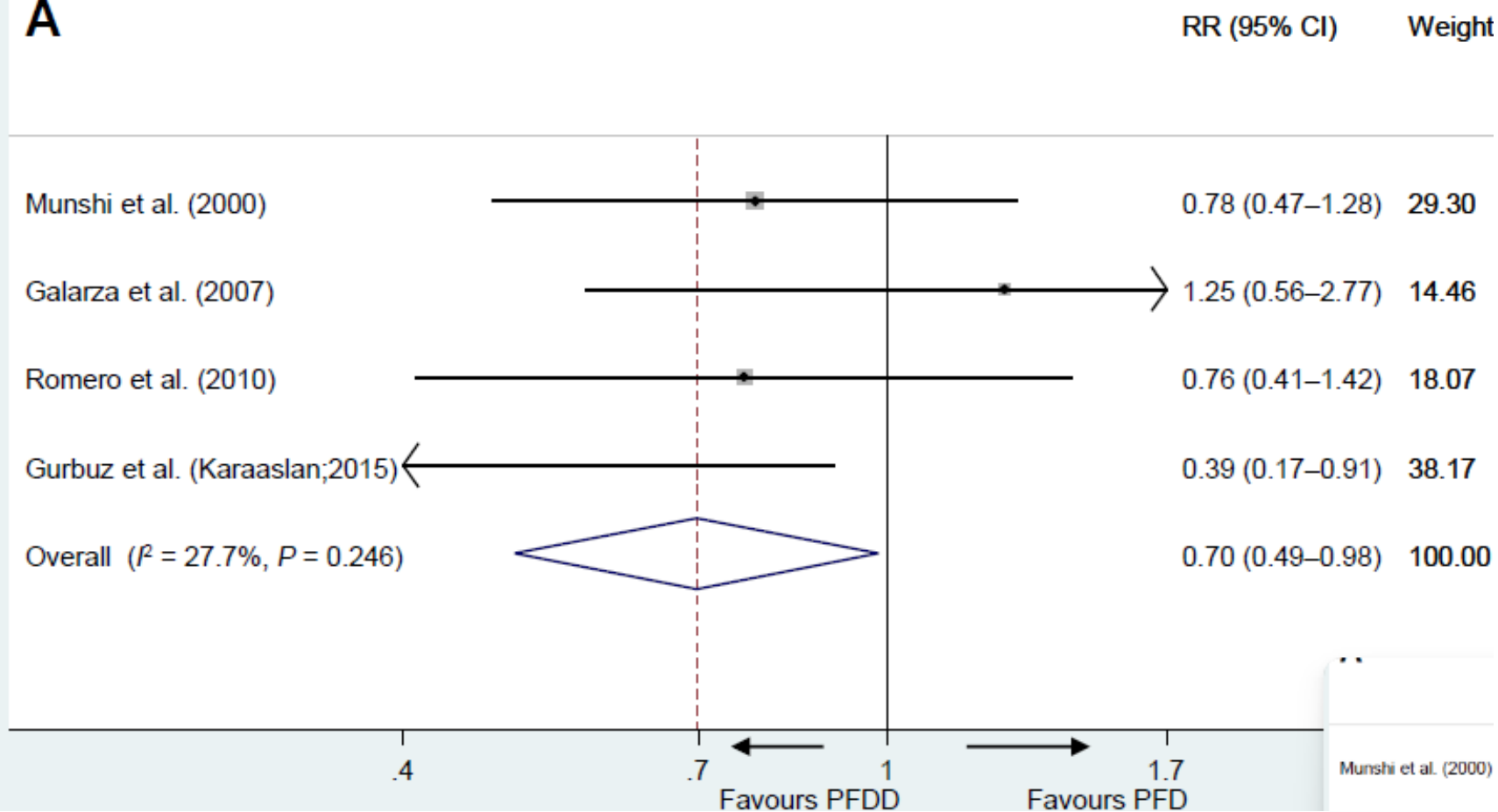
■ **BACKGROUND:** Posterior fossa decompression without (PFD) or with duraplasty (PFDD) for the treatment of type 1 Chiari malformation (CM-1) is controversial. We thus performed a systematic review and meta-analysis of studies to assess the effect on clinical and imaging improvement, operative time, complications, and recurrence rate between PFD and PFDD in patients with CM-1.

■ **METHODS:** We systematically searched PubMed, Embase, Cochrane, Web of Knowledge, and ClinicalTrials.gov for retrospective or prospective studies comparing PFD with PFDD. Our main end points were clinical and imaging improvement, operative time, complications, and recurrence rate. We assessed pooled data by use of a fixed-effects or random-effects model according to the between-study heterogeneity.

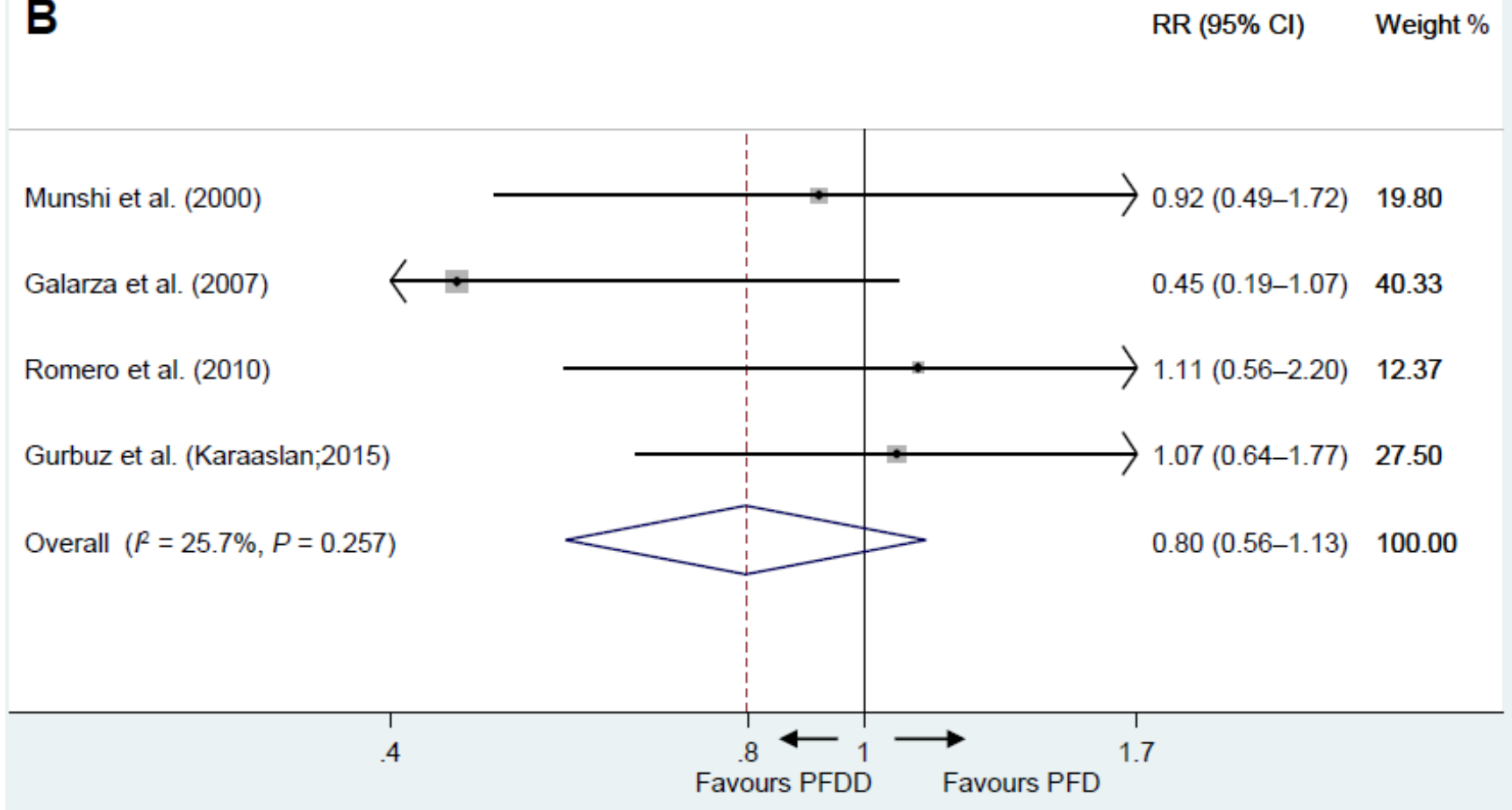
■ **RESULTS:** Of 214 identified studies, 13 were eligible and were included in our analysis ($N = 3481$ patients). Compared with PFD, PFDD led to a mean greater increase in operative time than did PFD [standardized mean difference, -2.35 ; 95% confidence interval [CI], $(-2.70$ to $-1.99)$], a higher likelihood of clinical improvement in patients with syringomyelia (relative risk [RR], 0.70; 95% CI, 0.49–0.98), no increased RR of clinical improvement in patients without syringomyelia, no increased RR of imaging improvement, but an increased RR of cerebrospinal fluid–related complications (RR, 0.29; 95% CI, 0.15–0.58), cerebrospinal fluid leak, aseptic meningitis, pseudomeningocele, and a decreased likelihood of recurrence rate.

■ **CONCLUSIONS:** PFDD can be an optimal surgical strategy because of its higher clinical improvement and lower recurrence rate in the patients with syringomyelia. In patients without syringomyelia, PFD can be a preferred choice because of its similar clinical improvement and lower costs. Future randomized studies with large numbers and the power to provide illumination for surgical decision making in CM-1 are warranted.

A



Clinical improvement in patients with syringomyelia

B

Clinical improvement in patients without syringomyelia



Radiological outcome after surgical treatment of syringomyelia-Chiari I complex in adults: a systematic review and meta-analysis

Paolo Perrini¹  · Yury Anania¹ · Federico Cagnazzo² · Nicola Benedetto¹ · Riccardo Morganti³ · Davide Tiziano Di Carlo¹

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Abstract

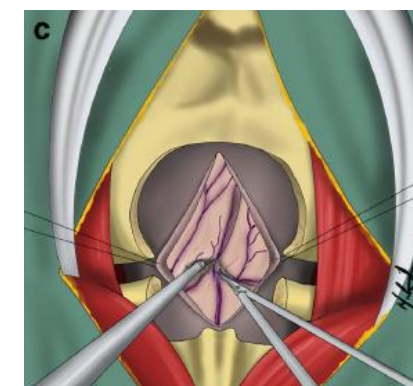
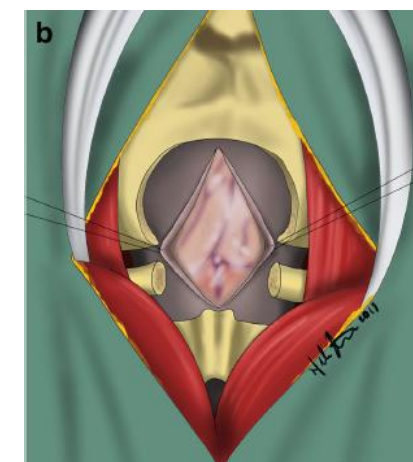
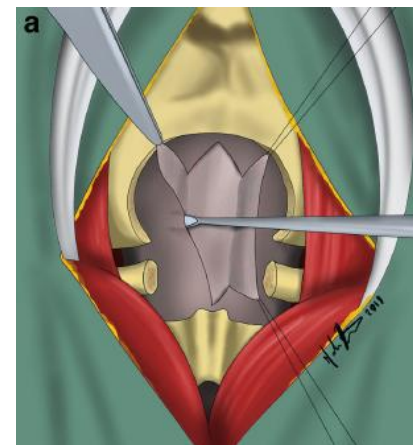
Foramen magnum decompression (FMD) is widely accepted as the standard treatment for syringomyelia associated with Chiari type I malformation (CMI). Despite extensive clinical investigations, relevant surgical details are still matter of debate. The authors performed a systematic review and meta-analysis of the literature examining the radiological outcome of syringomyelia in adult patients with CMI after different surgical strategies. PRISMA guidelines were followed. A systematic search of three databases was performed for studies published between 1990 and 2018. Our systematic review included 13 studies with a total of 276 patients with CMI associated with syringomyelia. Overall, the rate of post-operative radiological improvement at last follow-up was 81.1% (95% CI 73.3–88.9%; $p < 0.001$; $I^2 = 71.4\%$). The rate of post-operative syrinx shrinkage did not differ significantly among both groups of decompression with the extra-arachnoidal technique and arachnoid dissection (90%, 95% CI 85.1–94.8%, $I^2 = 0\%$ vs 79.8%, 95% CI 61.7–98%, $I^2 = 85.5\%$). A lower rate of post-operative radiological syrinx shrinkage was observed after decompression with splitting of the outer layer of the dura (55.6% 95% CI 40.5–70.8%, $I^2 = 0\%$). CSF-related complications and infections were similar among the different groups. Our meta-analysis found that FMD with the extra-arachnoidal technique and arachnoid dissection provides similar results in terms of post-operative shrinkage of syringomyelia. Patients undergoing decompression with splitting of the dura presented the lower rate of syrinx reduction. These data should be considered when choosing the surgical approach in adult patients with CMI associated with syringomyelia.

Keywords Chiari I malformation · Syringomyelia · Surgery · Foramen magnum decompression · Arachnoid exploration · Meta-analysis

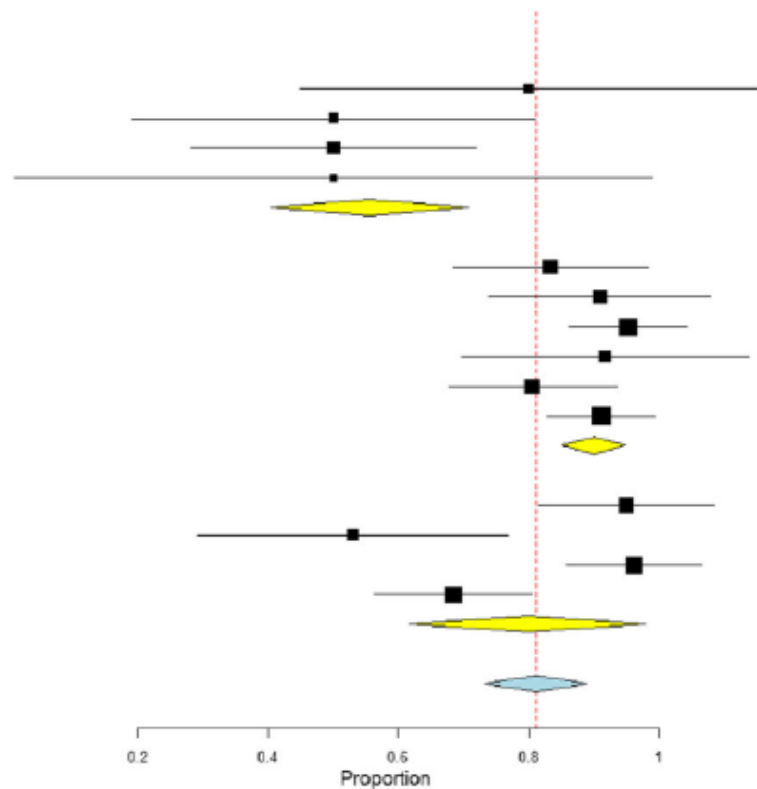
	Year	Design	N patients	M/F	Age (mean)	Syrinx	Median FU (months)
FMDds							
Chauvet et al. ⁷	2009	R	10	2\8	34.3	5	12
Kotil et al. ¹⁸	2009	P	10	4\6	44.4	10	25
Ono et al. ²⁶	2010	P	20	4\16	49.1	20	–
Romero et al. ³²	2010	R	6	3\3	40.7	4	–
FMDdo							
Perrini et al. ²⁷	2007	R	24	9\15	40	24	44
Rahman et al. ³⁰	2017	R	11	7\4	29.4	11	36
Rehman et al. ³¹	2015	P	21	8\13	–	21	–
Romero et al. ³²	2010	R	10	3\7	40.5	5	–
Spena et al. ³³	2010	R	36	17\19	40.4	36	40
Yilmaz et al. ⁴³	2011	R	58	–	38.9	45	–
FMDae							
Fischer et al. ¹²	1995	P	10 ^a	–	49	9	25.5
Pillay et al. ²⁸	1991	P	31 ^c	–	–	17	–
Prat et al. ²⁹	2009	P	12 ^b	3\9	43.6	12	12
Thakar et al. ³⁵	2018	R	57	30\27	38.3	57	–

Ae arachnoid exploration/dissection, *ds* dura splitting, *do* dura opening, *FMD* foramen magnum decompression, *FU* Follow-up, *P* prospective study, *R* retrospective study

^a 9 patients excluded; ^b 1 patients < 18 years old excluded; ^c 4 patients excluded due to other neurosurgical procedures; ^d 3 patients excluded due to other neurosurgical procedures



Studies	Estimate (95% C.I.)	Ev/Trt
1. Chauvet et al. (2009)	0.800 (0.449, 1.151)	4/5
2. Kotil et al. (2009)	0.500 (0.190, 0.810)	5/10
3. Ono et al. (2010)	0.500 (0.281, 0.719)	10/20
4. Romero et al. (2010)	0.500 (0.010, 0.990)	2/4
Subgroup FMDds ($I^2=0\%$, $P=0.515$)	0.556 (0.405, 0.708)	21/39
A. Perrini et al. (2007)	0.833 (0.684, 0.982)	20/24
B. Rahman et al. (2017)	0.909 (0.739, 1.079)	10/11
C. Rehman et al. (2015)	0.952 (0.861, 1.043)	20/21
D. Romero et al. (2010)	0.917 (0.696, 1.138)	5/5
E. Spina et al. (2010)	0.806 (0.676, 0.935)	29/36
F. Yilmaz et al. (2011)	0.911 (0.828, 0.994)	41/45
Subgroup FMDdo ($I^2=0\%$, $P=0.522$)	0.900 (0.851, 0.948)	125/142
a. Fischer et al. (1995)	0.950 (0.815, 1.085)	9/9
b. Pillay et al. (1991)	0.529 (0.292, 0.767)	9/17
c. Prat et al. (2009)	0.962 (0.857, 1.066)	12/12
d. Thakar et al. (2018)	0.684 (0.564, 0.805)	39/57
Subgroup FMDae ($I^2=85.51\%$, $P=0.000$)	0.798 (0.617, 0.980)	69/95
Overall ($I^2=71.4\%$, $P=0.000$)	0.811 (0.733, 0.889)	215/276



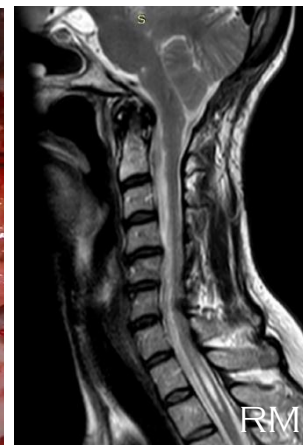
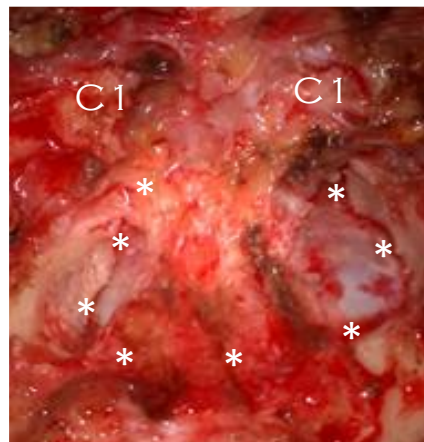
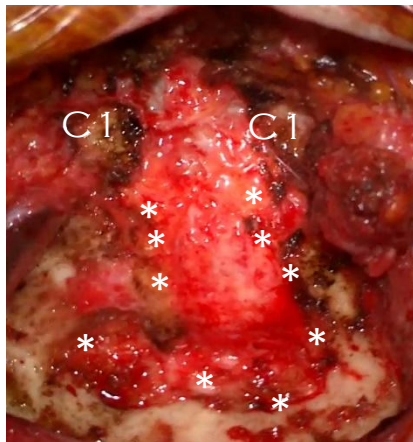
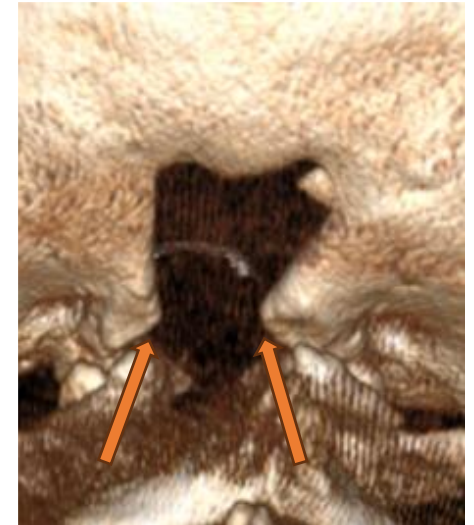
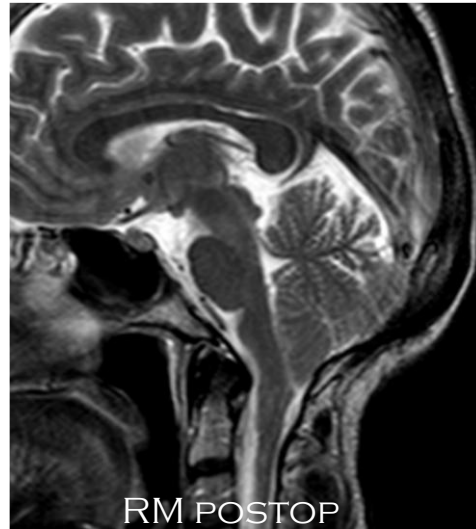
Paziente di 17 anni.

Pregresso intervento di decompressione ossea. Persistenza della cefalea a carattere ingravescente. Revisione aprile 2024.



INADEGUATA DECOMPRESSIONE OSSEA E MANCATA APERTURA DURALE

DONNA DI 53 ANNI CON OPERATA CON SEZIONE DEL FILUM TERMINALE, E SUCCESSIVA DECOMPRESSIONE OSSEA DEL FORAME MAGNO



OUTCOME DEL TRATTAMENTO CHIRURGICO DELLA MALFORMAZIONE DI CHIARI

- La CCOS è una scala adeguata ed affidabile per quantificare l'outcome dei pazienti operati per malformazione di Chiari sia adulti che pediatrici
- Ci sono evidenze che l'outcome è influenzato dal tipo di decompressione impiegata durante l'intervento
- La decompressione con duroplastica offre un miglior outcome clinico nei pazienti con malformazione di Chiari I e una maggiore percentuale di riduzione dellairingomielia



COMPLICANZE DEL TRATTAMENTO
CHIRURGICO DELLA
MALFORMAZIONE DI CHIARI

Le Complicanze sono funzione della tipologia di intervento



Decompressione ossea (CCD)

Decompressione durale

- multiple incisioni durali
- Rimozione dello strato durale esterno
- apertura durale

Dissezione aracnoidea + duroplastica (CCDD)

Coartazione delle tonsille

Resezione delle tonsille

Cranioplastica

Complicanze:

- 
- Meningite asettica
 - Idrocefalo
 - Pseudomeningocele
 - Fistola liquorale
 - Disturbi della deglutizione
 - Infarto cerebellare
 - Infezioni (infezione ferita, meningite batterica)



A retrospective single-center series on the surgical management and postoperative outcomes of pediatric Chiari malformation type I. Part 1: presentation, operative management, and complications

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¹Department of Neurological Surgery, University of Pittsburgh Medical Center, Pittsburgh; ²Division of Neurological Surgery, Children's Hospital of Pittsburgh; ³Department of Anesthesia and Perioperative Medicine, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania; ⁴Division of Pediatric Neurosurgery, Nationwide Children's Hospital, Columbus, Ohio; and ⁵Department of Neurosurgery, Duke Children's Hospital, Durham, North Carolina

OBJECTIVE Posterior fossa decompression is the main surgical treatment for Chiari malformation type I (CM-I). The authors present findings on patient presentation, surgical methods, and postoperative complications from a large cohort of pediatric patients with the aim of utilizing this institutional experience to guide evidence-based management of pediatric CM-I.

METHODS A departmental operative database was queried for patients who underwent a posterior fossa decompression for CM-I between 1992 and 2021. The charts of identified patients were reviewed. Data regarding demographics, presentation, operative details, and complications were collected.

RESULTS A total of 510 patients were identified. The mean patient age was 10.2 ± 5.2 years, and 57% of patients were female. The most common presenting clinical symptoms or associated signs were exertional suboccipital headaches (65%), syringomyelia (55%), and scoliosis (18%). The mean cerebellar tonsillar descent was 14.2 ± 6.4 mm below the foramen magnum. At surgery, 20% of the patients with a preoperative syrinx had documented arachnoid veils obstructing the outflow tract of the fourth ventricle. Operatively, 99% of patients underwent cervical laminectomy; of these laminectomies, 89% were C1 only. Ninety-seven percent of all patients underwent suboccipital craniectomy with expansile duraplasty (PFDD), while 3% underwent bone-only decompression (PFD). Eighty-seven percent of the patients with PFDD received tonsillectomy and/or tonsillar resection. The median postoperative hospital stay was 2 days for PFD patients and 3 days for PFDD patients ($p < 0.01$). Postoperative complications developed in 12% of cases, with CSF leakage (5%) and aseptic meningitis (4%) being most common. CSF leakage and aseptic meningitis were also the most common reasons for early readmission after surgery. There were no intraoperative or postoperative deaths.

CONCLUSIONS The authors demonstrate an institutional preference for PFDD and tonsillectomy. Exertional suboccipital pain and syringomyelia were the most common indications for surgery. Complications tended to be more common with PFDD. There was a significant difference in postoperative length of stay between patients who underwent PFD (median 2 days) versus PFDD (median 3 days). CSF leakage and aseptic meningitis were the most common reasons for readmission.

<https://thejns.org/doi/abs/10.3171/2025.6.PEDS22191>

KEYWORDS pediatric neurosurgery; Chiari malformation; syringomyelia; intradural decompression; postoperative complications

TABLE 2. Dural graft materials utilized in intradural decompressions

Graft Type	No. of Patients w/ Duraplasty (%)
Collagen graft	227 (48)
Cadaveric graft	93 (20)
Autologous pericranial graft	82 (17)
ePTFE	28 (6)
Bovine pericardium	18 (4)
Acellular dermal matrix	9 (2)
Autologous fascia lata	2
Autologous cervical fascia	1
Polyglactin-polydioxanone	1
None	14 (3)
Total	475

ePTFE = expanded polytetrafluoroethylene.

Numbers tally to fewer than the total number of patients who underwent PFDD (n = 481) as details regarding duraplasty type were not documented in 6 patients.

TABLE 3. Incidence of postoperative complications and the reasons for readmission within 30 days of discharge

Complication	No. of Patients (%)	
	Total	Readmitted w/in 30 Days of Op
CSF leak	26 (5)	20 (77)
Aseptic meningitis	22 (4)	16 (73)
Hydrocephalus	9 (2)	5 (56)
Bacterial meningitis	8 (2)	5 (63)
Wound dehiscence	8 (2)	8 (100)
Subdural hygroma/hematoma	2	2 (100)
Epidural hematoma	2	2 (100)
Cervical instability	1	—
Other reasons for readmission w/in 30 days		
Nausea/vomiting		9
Idiopathic intracranial hypertension		1
Pneumonia		1
Febrile seizure		1

Numbers tally to values greater than 63 for total complications and 54 in readmitted patients within 30 days as more than 1 patient presented with multiple complaints.



Perspective

Post-Operative Complications after Foramen Magnum Decompression with Duraplasty Using Different Graft Materials in Adults Patients with Chiari I Malformation: A Systematic Review and Meta-Analysis

Paolo Perrini ^{1,2,*} , Daniele Lorenzini ¹, Alberto Vercelli ¹, Alessandra Perrone ¹ and Davide Tiziano Di Carlo ^{1,2} 

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² Department of Translational Research on New Technologies in Medicine and Surgery, University of Pisa, 56126 Pisa, Italy

* Correspondence: paolo.perrini@unipi.it; Tel.: +39-50-996121

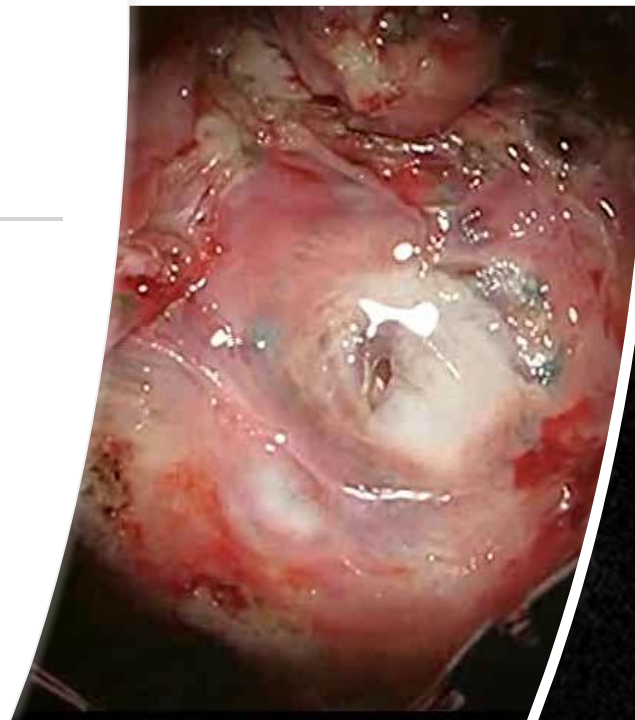
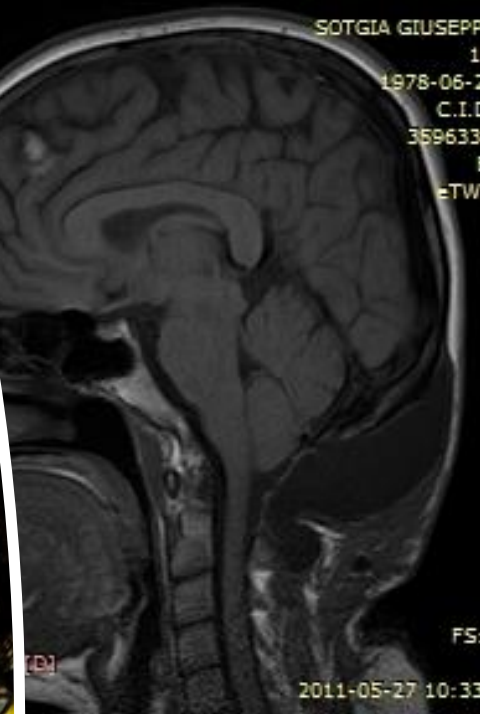
Abstract: Despite extensive investigations, the choice of graft material for reconstructive duraplasty after foramen magnum decompression for Chiari type I malformation (CMI) is still a topic of discussion. The authors performed a systematic review and meta-analysis of the literature examining the post-operative complications in adult patients with CMI after foramen magnum decompression and duraplasty (FMDD) using different graft materials. Our systematic review included 23 studies with a total of 1563 patients with CMI who underwent FMDD with different dural substitutes. The most common complications were pseudomeningocele (2.7%, 95% CI 1.5–3.9%, $p < 0.01$, $I^2 = 69\%$) and CSF leak (2%, 95% CI 1–2.9%, $p < 0.01$, $I^2 = 43\%$). The revision surgery rate was 3% (95% CI 1.8–4.2%, $p < 0.01$, $I^2 = 54\%$). A lower rate of pseudomeningocele was observed with autologous duraplasty when compared with synthetic duraplasty (0.7% [95% CI 0–1.3%] vs. 5.3% [95% CI 2.1–8.4%] $p < 0.01$). The rate of CSF leak and revision surgery was lower after autologous duraplasty than after non-autologous dural graft (1.8% [95% CI 0.5–3.1%] vs. 5.3% [95% CI 1.6–9%], $p < 0.01$ and 0.8% [95% CI 0.1–1.6%] vs. 4.9% [95% CI 2.6–7.2%] $p < 0.01$, respectively). Autologous duraplasty is associated with a lower rate of post-operative pseudomeningocele and reoperation. This information should be considered when planning duraplasty after foramen magnum decompression in patients with CMI.

Keywords: Chiari malformation; dural graft; duraplasty; surgery; pseudomeningocele; CSF leak



Citation: Perrini, P.; Lorenzini, D.; Vercelli, A.; Perrone, A.; Di Carlo, D.T. Post-Operative Complications after Foramen Magnum Decompression with Duraplasty Using Different Graft Materials in Adults Patients with Chiari I Malformation: A

Pseudomeningocele



Pseudomeningocele

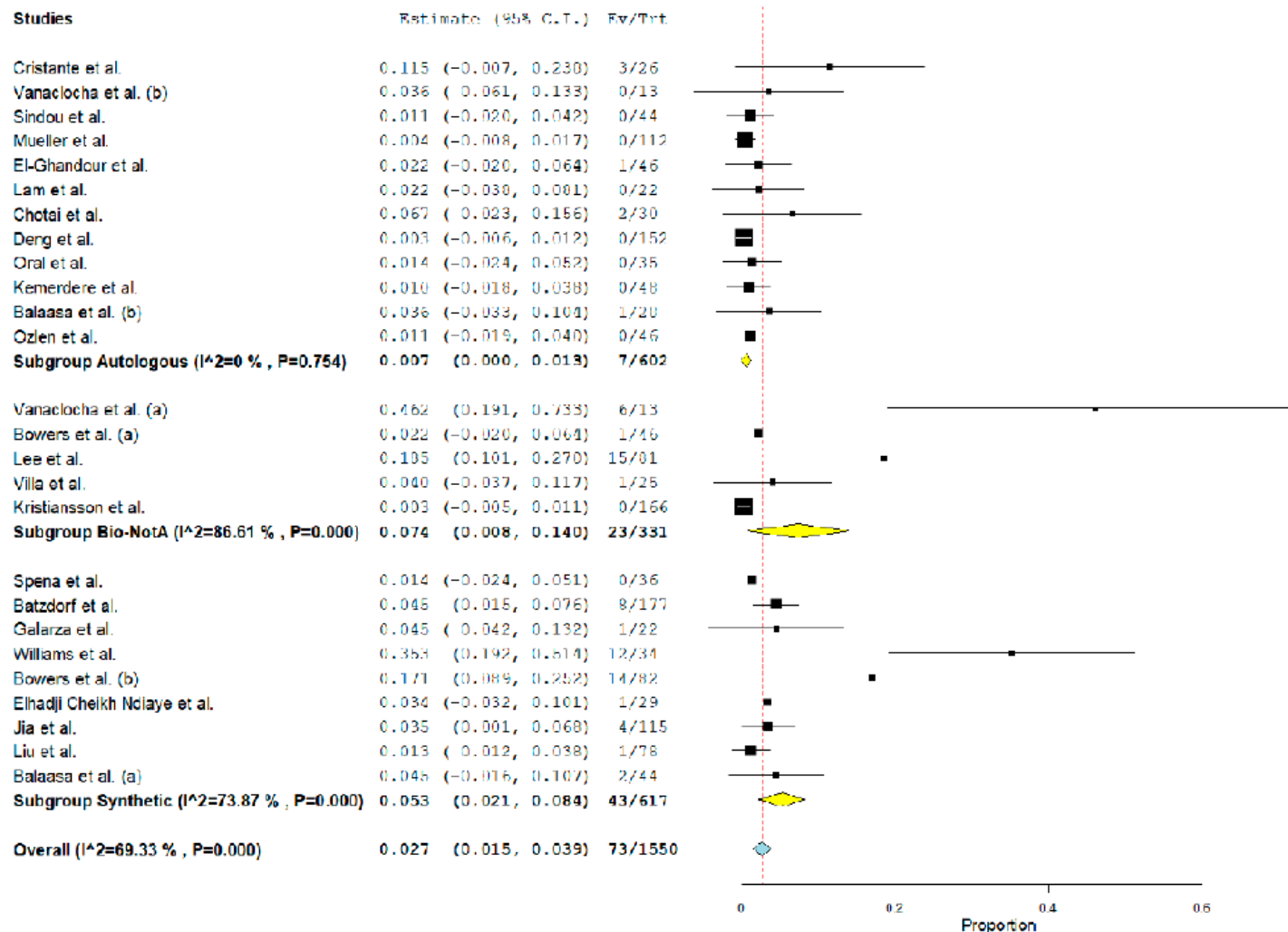


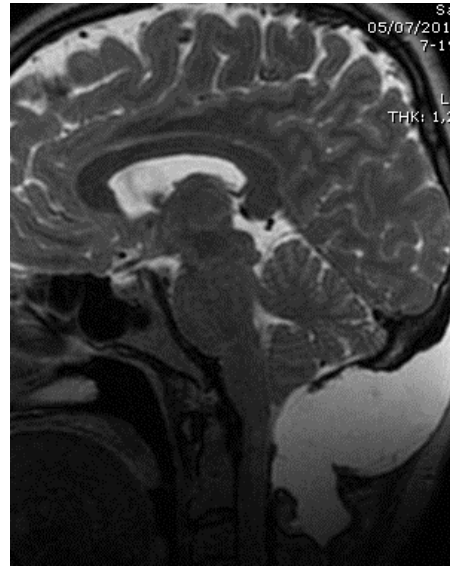
Figure 2. Forest plot detailing the pooled rate and 95% confidence intervals for the rate of post-operative PSMC accounted for graft material. Yellow diamond: sub-group pooled rate, blue diamond: overall pooled rate. The subgroup analysis demonstrated that the rate of PSMC was higher among biological nonautologous and synthetic groups [13–35].

PSEUDOMENINGOCELE POSTOPERATORIO

DONNA DI 32 ANNI CON CEFALEA DA SFORZO, VERTIGINI E PARESTESIE ARTI SUPERIORI.



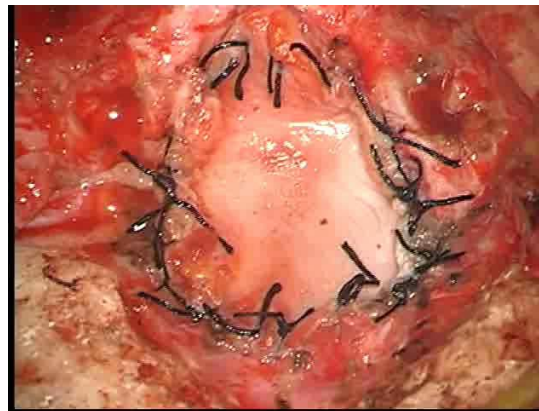
RM PREOPERATORIA



PSEUDOMENINGOCELE



REVISIONE CHIRURGICA



RM POST-REVISIONE
PSEUDOMENINGOCELE (5 ANNI)



Postoperative CSF Leak

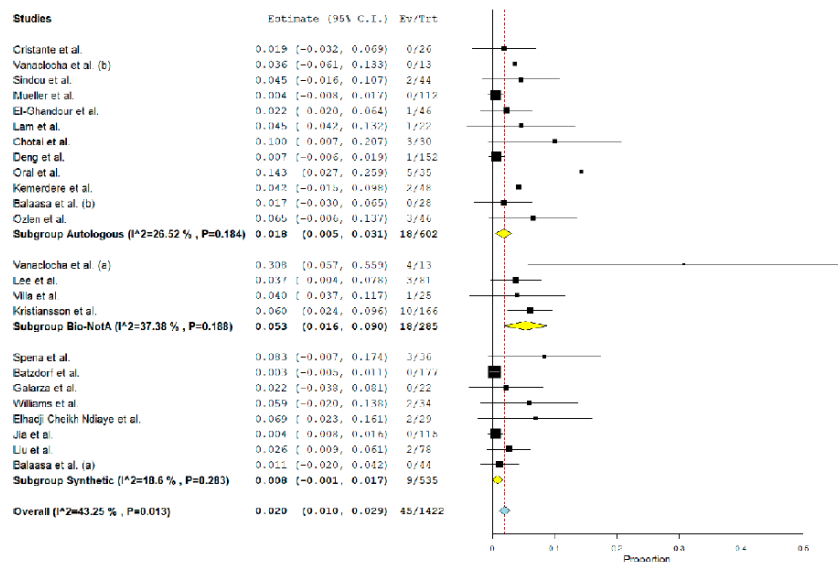


Figure 3. Forest plot detailing the pooled rate and 95% confidence intervals for the rate of post-operative CSF leak accounted for graft material. Yellow diamond: sub-group pooled rate, blue diamond: overall pooled rate. The subgroup analysis demonstrated that the rate of CSF leak was higher among biological nonautologous graft group [13–35].

Reintervento

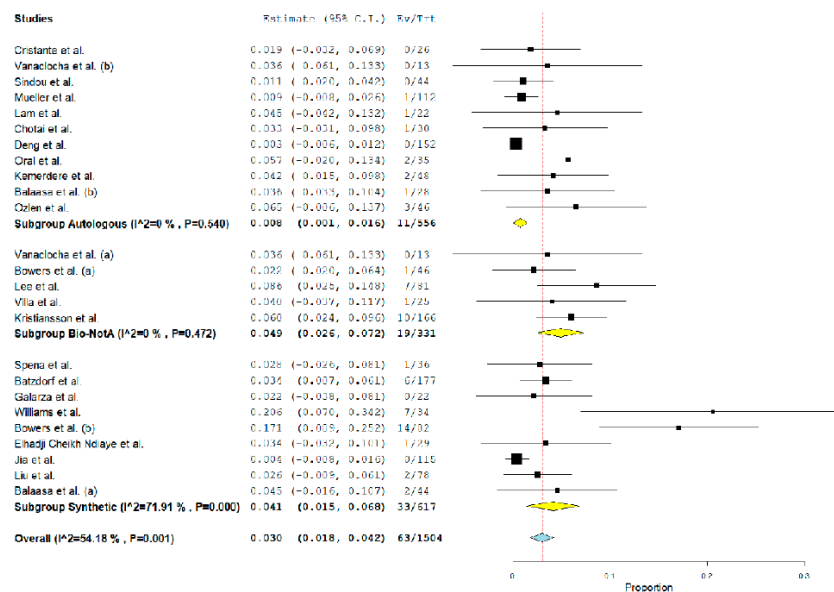


Figure 4. Forest plot detailing the pooled rate and 95% confidence intervals for the rate of reoperation accounted for graft material. Yellow diamond: sub-group pooled rate, blue diamond: overall pooled rate. The subgroup analysis demonstrated that the rate of PSMC was higher among biological nonautologous and synthetic groups [13–35].

Idrocefalo postoperatorio



Donna di 34 anni con storia di cefalea ingravescente, disturbi della deglutizione, parestesie. Sviluppo di idrocefalo ostruttivo due settimane dopo decompressione. Posizionamento di DVP (140 mmH₂O e poi 160 mmH₂O). Riduzione della siringomielia al controllo RM 2 anni dopo l'intervento.

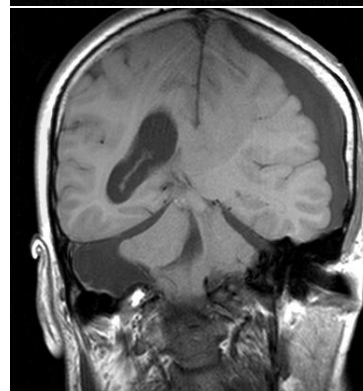
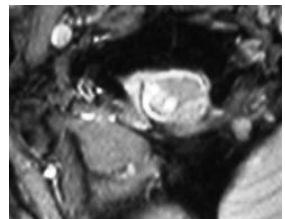
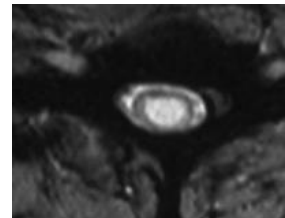
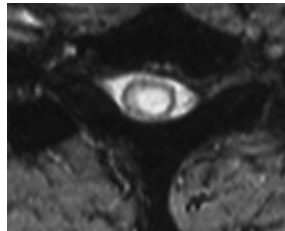
CASE REPORT

Acute external hydrocephalus complicating craniocervical decompression for syringomyelia–Chiari I complex

Case report and review of the literature

Paolo Perrini • Alexander Rawlinson •
Richard Alfred Cowie • Andrew Thomas King

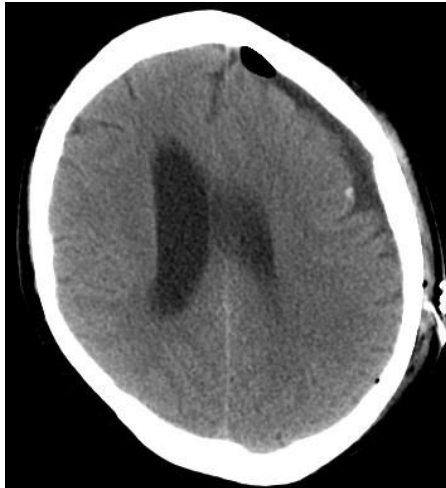
Uomo di 37 anni con cefalea da sforzo, disturbi di deglutizione, parestesie distali



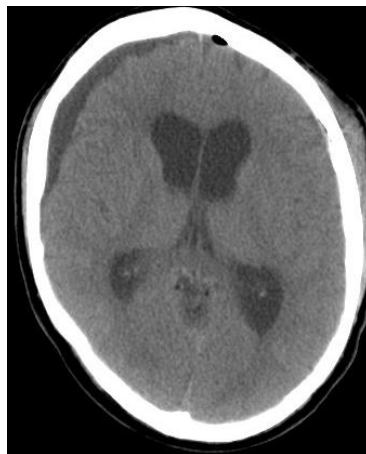
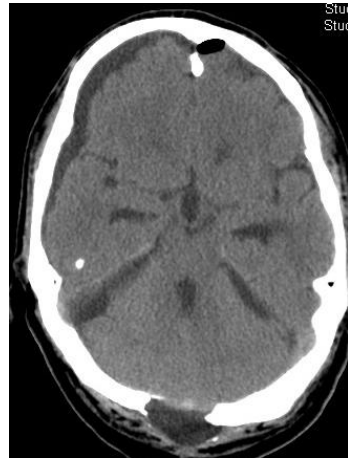
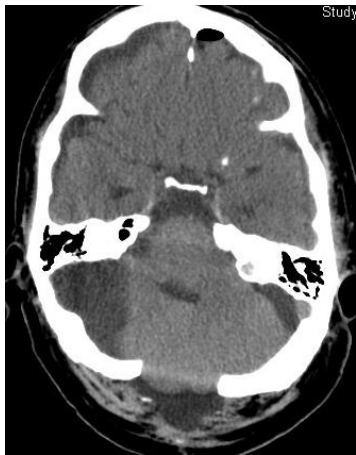
Dopo FMD con dissezione aracnoidea sviluppo di cefalea e deficit arto superiore destro



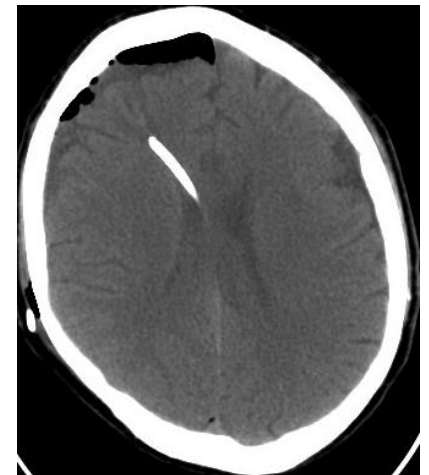
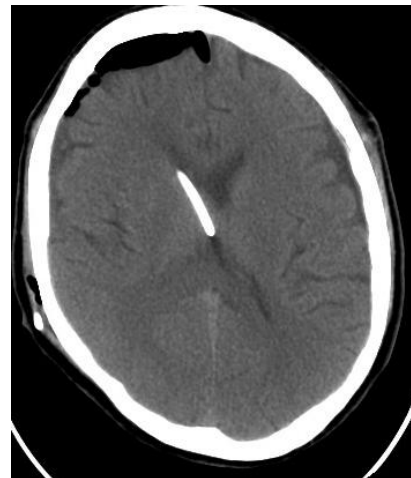
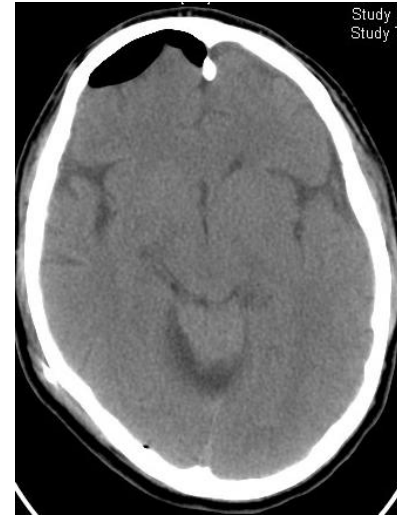
TC nel primo giorno postop



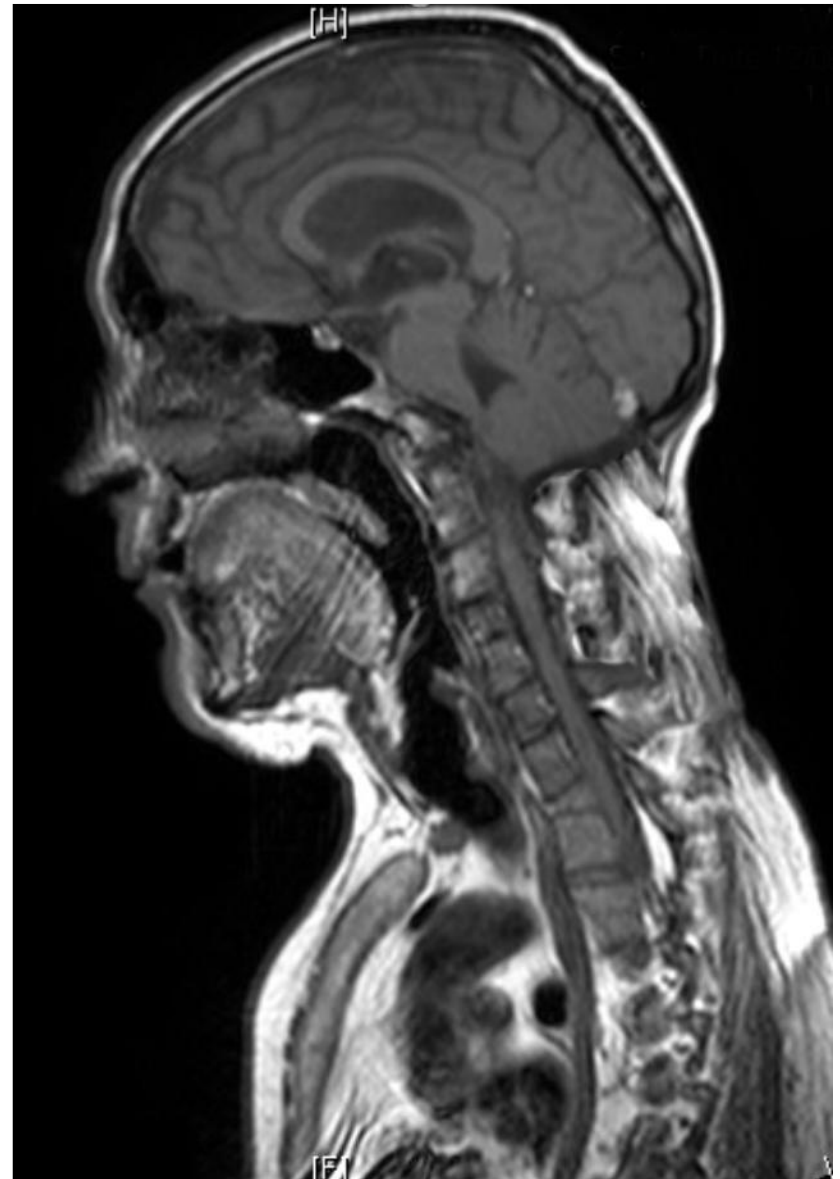
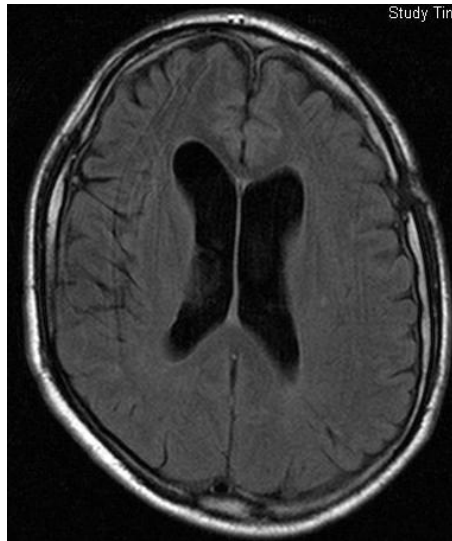
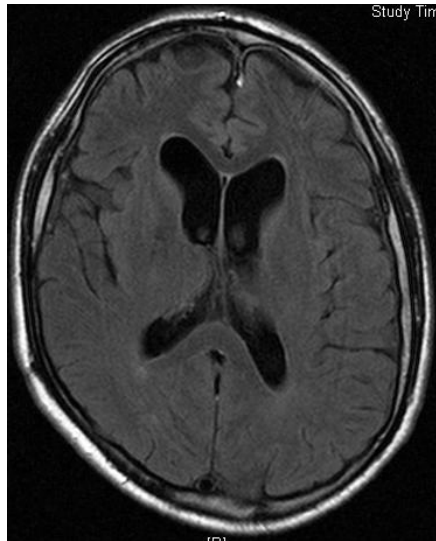
CT scan on seventh postoperative day
(patient complaining mild headache)



CT scan after ventriculo-peritoneal shunt



MR 2 years after VP shunt



Ectasia durale

PEER-REVIEW REPORTS

Posterior Fossa Reconstruction Using Titanium Plate for the Treatment of Cerebellar Ptosis After Decompression for Chiari Malformation

Vikram Udani, Langston T. Holly, Daniel Chow, Ulrich Batzdorf

Key words

- Cerebellar ptosis
- Chiari malformation
- Cranioplasty
- Dural ectasia
- Titanium plate

Abbreviations and Acronyms

CM: Chiari malformation
CSF: Cerebrospinal fluid
ePTFE: Polytetrafluoroethylene
PFD: Posterior fossa decompression



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Citation: *World Neurosurg.* (2014).

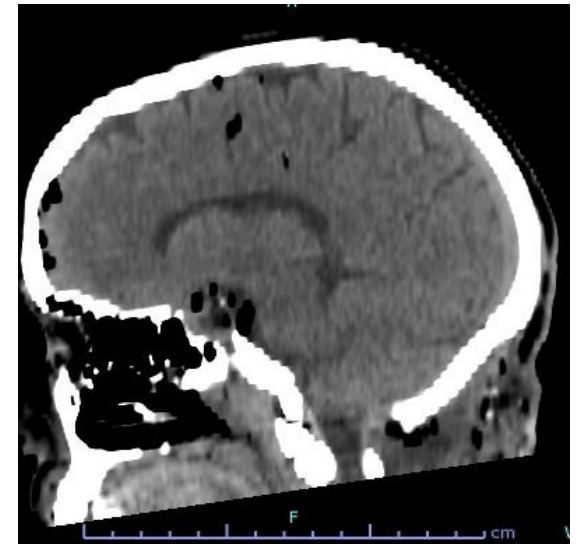
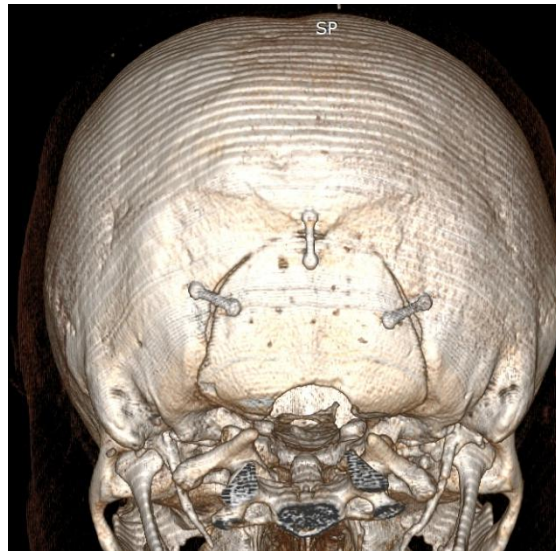
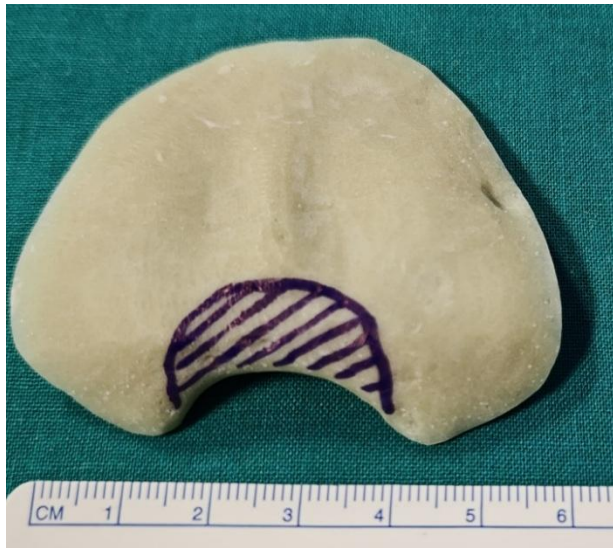
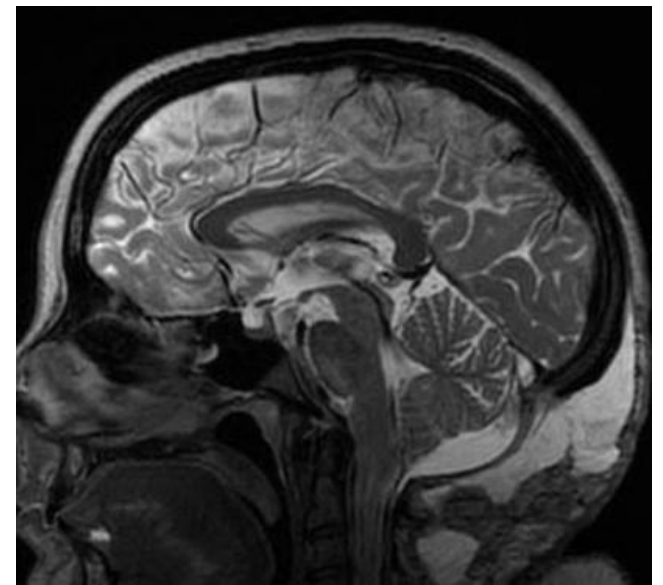
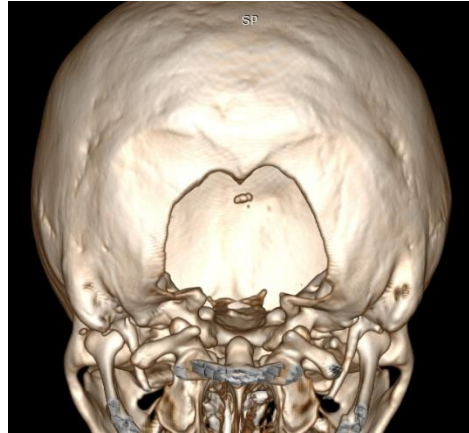
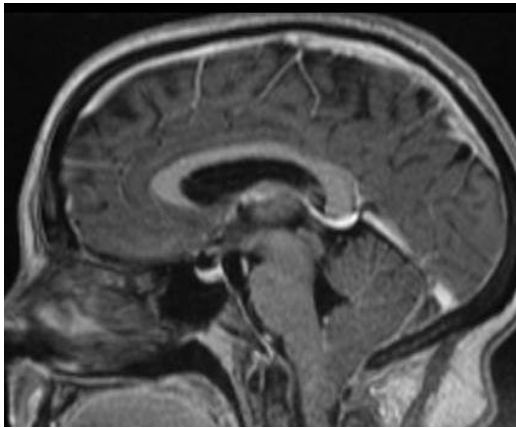
<http://dx.doi.org/10.1016/j.wneu.2013.01.081>

■ **OBJECTIVE:** We describe our use of a perforated titanium plate to perform a partial posterior fossa cranioplasty in the treatment of cerebellar ptosis and dural ectasia after posterior fossa decompression (PFD).

■ **METHODS:** Twelve patients who had undergone PFD underwent posterior fossa reconstruction using a titanium plate. Symptoms were related to either descent of the cerebellum into the decompression or to dural ectasia into the craniectomy defect.

■ **RESULTS:** Twelve patients who had undergone large suboccipital craniectomies and who presented with persistent headaches and some with neurological symptoms related to syringomyelia, underwent reoperation with placement of a small titanium plate. Ten of 12 patients showed symptomatic improvement after reoperation.

■ **CONCLUSIONS:** Placement of a titanium plate appears to be an effective method of treatment of cerebellar ptosis and dural ectasia after PFD for Chiari malformation.



Donna di 33 anni con cefalea da sforzo e cervicalgia. Decompressione della fossa posteriore 40 x 50 mm presso altra struttura con sviluppo di cefalea diffusa. Revisione chirurgica con cranioplastica custom-made in ceramica con FMD

COMPLICANZE CHIRURGICO DELLA MALFORMAZIONE DI CHIARI

- Le complicanze postoperatorie interessano il 12-15% dei pazienti sottoposti a decompressione per malformazione di Chiari I
- Le complicanze più frequenti coinvolgono le alterazioni della circolazione liquorale (pseudomeningocele, CSF leak, meningite asettica)
- Il materiale impiegato nella duroplastica influenza la frequenza di comparsa delle complicanze liquorali (Plastica autologa vs sintetica)

GRAZIE



AISMAC
Associazione Italiana Siringomielia e Chiari

Consorzio Interregionale
Siringomielia Chiari di Cisti

Malformazione di CHIARI e SIRINGOMIELIA

diagnosi, trattamento, vita quotidiana

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Ministero della Sanità

SPART
Società per lo studio e la cura delle patologie neurologiche

Iniziativa realizzata nell'ambito del progetto SMART 2.0 con il finanziamento ministeriale
concesso per l'anno 2024 al sensi dell'art. 72, primo comma, del D.Lgs n. 117 del 2017 s.m.l.