

Received: 2015.12.04  
Accepted: 2016.02.03  
Published: 2016.10.14

# Application of COMPONT Medical Adhesive Glue for Tension-Reduced Duraplasty in Decompressive Craniotomy

Authors' Contribution:  
Study Design A  
Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
Funds Collection G

B **Yujia Zhou**  
A **Gesheng Wang**  
B **Jialin Liu**  
C **Yong Du**  
E **Lei Wang**  
E **Xiaoyong Wang**

Department of Neurosurgery, Dongfang Hospital of Beijing University of Chinese Medicine, Beijing, China

**Corresponding Author:** Gesheng Wang, e-mail: wanggesheng2015@163.com  
**Source of support:** Departmental sources

**Background:** The aim of this study was to evaluate the application of medical adhesive glue for tension-reduced duraplasty in decompressive craniotomy.

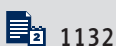
**Material/Methods:** A total of 56 cases were enrolled for this study from Jan 2013 to May 2015. All patients underwent decompressive craniotomy and the dura was repaired in all of them with tension-reduced duraplasty using the COMPONT medical adhesive to glue artificial dura together. The postoperative complications and the healing of dura mater were observed and recorded.

**Results:** No wound infection, epidural or subdural hematoma, cerebrospinal fluid leakage, or other complications associated with the procedure occurred, and there were no allergic reactions to the COMPONT medical adhesive glue. The second-phase surgery of cranioplasty was performed at 3 to 6 months after the decompressive craniotomy in 32 out of the 56 cases. During the cranioplasty we observed no adherence of the artificial dura mater patch to the skin flap, no residual COMPONT glue, or hydropic or contracture change of tissue at the surgical sites. Additionally, no defect or weakening of the adherence between the artificial dura mater patch and the self dura matter occurred.

**Conclusions:** COMPONT medical adhesive glue is a safe and reliable tool for tension-reduced duraplasty in decompressive craniotomy.

**MeSH Keywords:** **Brain Injuries • Craniotomy • Surgery Department, Hospital**

**Full-text PDF:** <http://www.medscimonit.com/abstract/index/idArt/896982>



1132



2



1



34



## Background

Repair of dural defects is an important component of many neurosurgeries [1–6]. Appropriate repair of dura not only effectively protects the brain tissue, but also prevents leakage of cerebrospinal fluid, intracranial infections, epilepsy, brain swelling, and other complications. For patients undergoes decompressive craniectomy, tension-reduced duraplasty is usually required, which is often performed by suturing with autologous dura with fascia membrane, periosteum, or artificial dura mater to achieve complete repair of defects of dura mater [7–11].

Along with the development of medical technology in recent years, synthetic medical glue is increasingly replacing the traditional suture method used by plastic surgeons in repair of dura mater tissue. Herein, we reported our experience of application of COMPONT glue for tension-reduced duraplasty in decompressive craniectomy, with satisfactory clinical outcomes.

## Material and Methods

### Subjects

A total of 56 patients were enrolled into the study from Jan 2013 to May 2015 at Beijing University of Chinese Medicine Neurosurgery East Hospital. The patients were 39 males and 17 females, aged 21 to 72 years. Among them, 21 had severe traumatic brain injury (subdural hematoma in 9 cases, 12 cases of epidural hematoma), 33 had hypertensive cerebral basal ganglion area hemorrhage, and 2 had acute massive cerebral infarction, both on the right side of the brain hemispheric infarction. Indications for surgery were adopted from the brain trauma surgery guideline published by the American Association of Neurological Surgeons, including: (1) traumatic brain injury and acute progressive disturbance of consciousness, and (2) cerebral contusion and hemorrhage, cerebral edema, brain swelling, or cerebral infarction-caused uncontrollable intracranial hypertension or pupil dilation with significant intra-cerebral space-occupying effect shown as midline shift or basal cistern compression on CT [12,13].

### Materials

The artificial dura material was manufactured by Beijing Xintianfu Co., Ltd. The artificial dura mater was fixed with autologous dura by using the  $\alpha$ -cyano-n-butylacrylate-based COMPONT adhesive glue made by Beijing Compont Medical Devices Co., Ltd.

### Surgical procedures

All the 56 patients were operated on with standard large decompressive craniectomy by the same surgical team, with

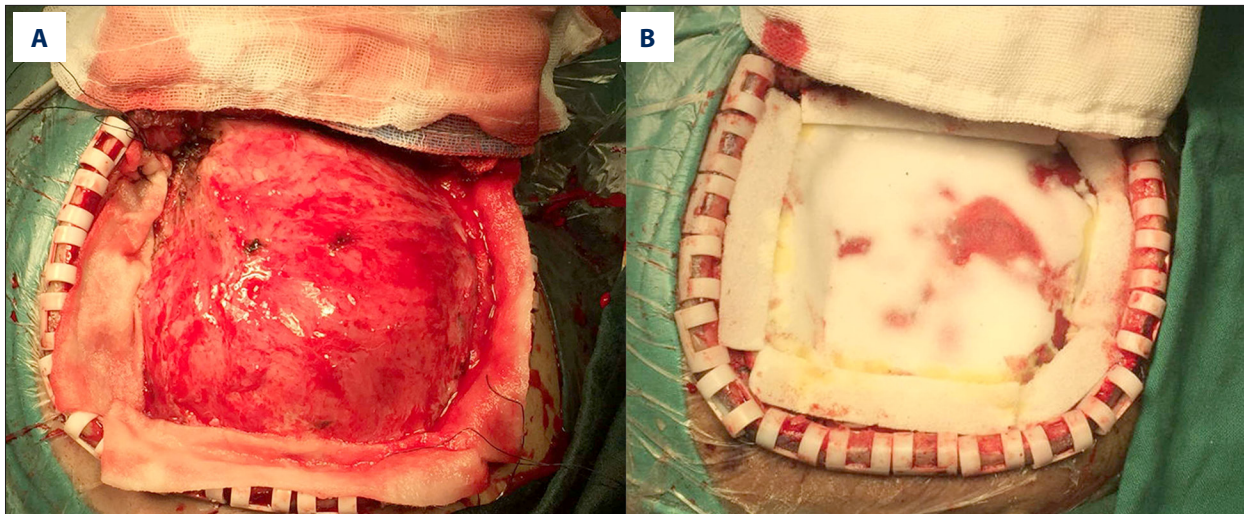
minor modifications [14]. In brief, the procedure consisted of the following sequential steps: (1) Making a frontotemporal incision by starting from 1 cm anterior to the tragus and above the zygomatic arch, going upward in the direction of vertical to the zygomatic arch, then extending upward postauricularly to the midline, ending forward along the midline to the forehead at the hairline. (2) Making a bone window by removing the bone flap with the top flap edge 2 to 3 cm from the midline, and the bottom of the bone window close to anterior and middle skull bases (Figure 1A). (3) Radially cutting dura, removing intracranial hematoma or necrotic brain tissue, and hemostasis. (4) Covering the brain tissue under the bone window with the artificial dura mater patches, using gelatin sponge patch to cover the artificial-autologous dura junctional edge, followed by evenly spraying the COMPONT medical glue to stick the glueatin sponge patch, the artificial dura and the autologous dura together (Figure 1B).

### Follow up

Post-operative complications, including secondary intracranial hemorrhage, cerebrospinal fluid leakage, wound infection, and hematoma were monitored and recorded. In skull repair of 2 patients, dural healing was observed in the patients undergoing second phase cranioplasty. Regular post-operative CT was used to evaluate intra-cerebral healing.

## Results

Among all the 56 surgical patients, 1 died within 72 h of the operation due to acute renal failure. Incisions healed normally in the other 55 patients without allergy to the artificial materials observed. Two patients died of multiple organ failure within 1 month of surgery. In the remaining 53 cases, head CT examination was done at 2 days, 1 week, 1 month, and three months after surgery, which revealed postoperative cerebral infarction in 2 cases, without radiographic abnormalities of the artificial dura mater patch (Table 1). The second-phase skull repair was done in 32 patients at 3–6 months after the decompressive craniotomy. During the surgery, no adherence of the skin flap to the dura was noted, and complete healing was observed between the artificial dura mater and autologous dura, without local defects, residual medical adhesive glue, tissue swelling, or contracture present. Long-term follow-up of 38 patients for 6–9 months revealed 2 cases with epilepsy, and no cerebrospinal fluid leak, effusion, seroma, wound infection, epilepsy, or other complications were identified (Table 2).



**Figure 1.** Intraoperative application of the COMPACT glue. After the cranial bone window was created (A), the glue was applied to fix the dura (B).

**Table 1.** Demographic data.

	Male	Female	Total
Case#	39	17	56
Age (years)	51.3±12.4	50.2±14.6	51.0±13.0
Subdural hematoma	7	2	9 (16.0%)
Extradural hematoma	9	3	12 (21.4%)
Hypertensive infarction	23	10	33 (58.9%)
Acute cerebral infarction	0	2	2 (3.6%)
Cranioplasty 3months later	20	12	32 (57.1%)

**Table 2.** Post-operative complications.

	Within 72 h	72 h–1 m	1–6 m
Cerebral infarction	–	2	–
Epilepsy	–	–	2
Death	1	2	–

## Discussion

Dura defects are common in neurosurgery. When cerebral herniation is formed due to severe brain tissue or brain swelling, as seen resulting from a variety of conditions (e.g., severe brain injury, cerebral hemorrhage, and acute cerebral infarction), the dura is often left open and unsutured for effective decompression in decompressive craniotomy. As the dura is a barrier blocking communication of intracranial and extracranial structures/materials, dural defect can lead to a series of complications such as postoperative cerebrospinal fluid leakage, subcutaneous fluid accumulation, cerebral rebleeding, and intracranial infection,

which in turn potentially deteriorates neurological damages and may adversely affect recovery and prognosis. These risks of complications necessitate duraplasty during decompressive craniotomy. Accumulating data have shown that tension-reduced duraplasty with artificial dura mater material can effectively reduce leakage of cerebrospinal fluid and occurrence of secondary seizure [15–18]. Our data demonstrate that synthetic medical glue has a great advantage in tension-reduced duraplasty, with satisfactory results but minimal complications.

The medical glue used in the study was a highly pure  $\alpha$ -cyanoacrylate compound with unique mesh structure that can firmly

stick dural tissue together [19–21]. The carbon atom on the  $\alpha$  position of the CNCH<sub>2</sub>CCOOR structure connects to highly electronegative-charged groups such as cyano group and ester groups, while the carbon atoms on the  $\beta$  position undergo rapid polymerization when in contact with very small amounts of water, amino group, weak base, alcohol, or anions. This process occurs fastest in living tissue, which usually results in a strong and instant bonding without any catalyst [22–25].

The  $\alpha$ -cyanoacrylate-containing medical glue has excellent adhesion ability, good permeability, and low risk of allergy [26,27]. The heat generated during polymerization process is minimal and the material itself is sterile, with antibacterial effects [27–29]. Clinical data has proven its effectiveness, biosafety, and reliability [30–34] in its wide use as a binder, hemostatic agents, sealers, or embolic agents in various settings. Our experience with this material in duraplasty revealed

that  $\alpha$ -cyanoacrylate glue is an effective and safe surgical material for use in tension-reduced duraplasty in decompressive craniectomy. Due to its ease of use, application of the medical glue also shortened duration of surgery compared to that with conventional suturing method.

## Conclusions

One of the trends in neurosurgery is using new technology and new materials to reduce incidence of postoperative complications and improve success of surgery. The COMPACT glue is one of the options to achieve these goals.

## Conflict of interest

All the authors declare that they have no conflict of interest.

## References:

1. Yang VX, Pirouzmand F: A simple method for controlled reduction duraplasty during cranioplasty. *Br J Neurosurg*, 2015 [Epub ahead of print]
2. Sinha S, Raheja A, Garg M et al: Decompressive craniectomy in traumatic brain injury: A single-center, multivariate analysis of 1,236 patients at a tertiary care hospital in India. *Neurol India*, 2015; 63(2): 175–83
3. Ogiwara H, Morota N: Surgical decompression without dural opening for symptomatic Chiari type II malformation in young infants. *Child Nerv Syst*, 2013; 29(9): 1563–67
4. Liu XS, You C, Lu M, Liu JG: Growing skull fracture stages and treatment strategy. *J Neurosurg Pediatr*, 2012; 9(6): 670–75
5. Yilmaz A, Kanat A, Musluman AM et al: When is duraplasty required in the surgical treatment of Chiari malformation type I based on tonsillar descending grading scale? *World Neurosurg*, 2011; 75(2): 307–13
6. Guresir E, Vatter H, Schuss P et al: Rapid closure technique in decompressive craniectomy. *J Neurosurg*, 2011; 114(4): 954–60
7. Williams LE, Vannemreddy PS, Watson KS, Slaviv KV: The need in dural graft suturing in Chiari I malformation decompression: A prospective, single-blind, randomized trial comparing sutured and sutureless duraplasty materials. *Surg Neurol Int*, 2013; 4: 26
8. Abuzayed B, Tuzgen S, Canbaz B et al: Reconstruction of growing skull fracture with *in situ* galeal graft duraplasty and porous polyethylene sheet. *J Craniofac Surg*, 2009; 20(4): 1245–49
9. Shimizu S, Koizumi H, Kurita M et al: Duraplasty in the posterior fossa using a boat-shaped sheet of expanded polytetrafluoroethylene. *Neurol Med Chir*, 2007; 47(8): 379–81; discussion 381
10. Miyake S, Fujita A, Aihara H, Kohmura E: New technique for decompressive duraplasty using expanded polytetrafluoroethylene dura substitute – technical note. *Neurol Med Chir*, 2006; 46(2): 104–6; discussion 106
11. Megyesi JF, Ranger A, MacDonald W, Del Maestro RF: Suturing technique and the integrity of dural closures: An *in vitro* study. *Neurosurgery*, 2004; 55(4): 950–54; discussion 954–55
12. Bullock MR, Chesnut R, Ghajar J et al: Surgical management of traumatic parenchymal lesions. *Neurosurgery*, 2006; 58(3 Suppl.): S25–46; discussion S1–iv
13. Hartings JA, Vidgeon S, Strong AJ et al: Surgical management of traumatic brain injury: A comparative-effectiveness study of 2 centers. *J Neurosurg*, 2014; 120(2): 434–46
14. Yamaura A, Uemura K, Makino H: Large decompressive craniectomy in management of severe cerebral contusion. A review of 207 cases. *Neurol Med Chir*, 1979; 19(7): 717–28
15. Malliti M, Page P, Gury C et al: Comparison of deep wound infection rates using a synthetic dural substitute (neuro-patch) or pericranium graft for dural closure: A clinical review of 1 year. *Neurosurgery*, 2004; 54(3): 599–603; discussion 603–4
16. Burckhardt BW, Guerra CP: Synthetic dural graft septoplasty in epistaxis from hereditary hemorrhagic telangiectasia. *Colomb Med*, 2013; 44(3): 189–91
17. von der Brölie C, Soehle M, Clusmann HR: Intraoperative sealing of dural mater defects with a novel, synthetic, self adhesive patch: Application experience in 25 patients. *Br J Neurosurg*, 2012; 26(2): 231–35
18. Shivapathasundram G, Stoodley MA: Use of a synthetic dural substitute to prevent ventral retethering in the management of diastematomyelia. *J Clin Neurosci*, 2012; 19(4): 578–81
19. Noszczyk W, Kurnatowski W, Kalcak M et al: [Treatment of gastric wounds in rats using alpha-cyanoacrylate adhesives]. *Zeitschrift für experimentelle Chirurgie*, 1971; 4(5): 313–17 [in German]
20. Sammartino R, Torrisi V, Disca C, Vasile S: [Use of tissue adhesives in oral surgery]. *Stomatol Mediter*, 1990; 10(4): 287–90 [in Italian]
21. Caroli A, Marcuzzi A, Limontini S, Maiorana A: [An experimental study of a cyanoacrylate biological adhesive in view of its use in the fixation of various fractures of the fingers]. *Ann Chir Main Memb Super*, 1997; 16(2): 138–45 [in French]
22. Ma LL, Zeng XQ, Lian JJ et al: [Use of endoscopic tissue adhesive injection for gastric varices]. *Zhonghua Wei Chang Wai Ke Za Zhi*, 2012; 15(7): 691–93 [in Chinese]
23. Tang J, Lv F, Li W et al: Contrast-enhanced sonographic guidance for local injection of a hemostatic agent for management of blunt hepatic hemorrhage: A canine study. *Am J Roentgenol*, 2008; 191(3): W107–11
24. Moretti Neto RT, Mello I, Moretti AB et al: *In vivo* qualitative analysis of the biocompatibility of different cyanoacrylate-based adhesives. *Braz Oral Res*, 2008; 22(1): 43–47
25. Cai P, Liu GH, Hua QQ: [Application of alpha-cyanoacrylate medical adhesive in fixation of intratemporal facial nerve within chitin chamber]. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi*, 2002; 16(3): 158–60 [in Chinese]
26. Agarwal A, Varma A, Sarkar C: Histopathological changes following the use of biological and synthetic glue for dural grafts: An experimental study. *Br J Neurosurg*, 1998; 12(3): 213–16
27. Papadakis N, Mark VH: Repair of spinal cerebrospinal fluid fistula with the use of a tissue adhesive: Technical note. *Neurosurgery*, 1980; 6(1): 63–65
28. Ogungbo BI, Nath FP: A technique for dural repair following retromastoid suboccipital craniectomy. *Br J Neurosurg*, 1998; 12(1): 45–46
29. Wiwanitkit V: Cyanoacrylate tissue adhesive. *Indian J Ophthalmol*, 2010; 58(4): 347; author reply 347–48
30. Ozer MT, Sinan H, Saydam M et al: Effectiveness of N-butyl cyanoacrylate-based microbial skin sealant on the prevention of surgical site infections. *Surg Infect*, 2014; 15(1): 14–17

31. Petter-Puchner AH, Simunek M, Redl H et al: A comparison of a cyanoacrylate [corrected] glue (Glubran) vs. fibrin sealant (Tisseel) in experimental models of partial pulmonary resection and lung incision [corrected] in rabbits. *J Invest Surg*, 2010; 23(1): 40–47
32. Moorthy S, Jhanji V, Constantinou M et al: Clinical experience with N-butyl cyanoacrylate tissue adhesive in corneal perforations secondary to herpetic keratitis. *Cornea*, 2010; 29(9): 971–75
33. Losi P, Burchielli S, Spiller D et al: Cyanoacrylate surgical glue as an alternative to suture threads for mesh fixation in hernia repair. *J Surg Res*, 2010; 163(2): e53–58
34. Zeikus P, Dufresne R: Novel technique for use of cyanoacrylate in Mohs surgery. *Dermatol Surg*, 2006; 32(7): 943–44