

## Autologous bone dust technique for one burr hole surgery to prevent severe skin depression



Shinya Ichimura\*, Masahito Fukuchi, Kento Takahara, Masato Nakaya, Keisuke Yoshida, Yoichi Mochizuki, Koji Fujii

Department of Neurosurgery, Shizuoka City Shimizu Hospital, Shizuoka, Japan

### ARTICLE INFO

#### Keywords:

Autologous bone dust  
One burr hole surgery  
Skin depression  
Osteogenesis  
Chronic subdural hematoma

### ABSTRACT

**Objective:** One burr hole surgery is a common treatment modality for initial chronic subdural hematoma and stereotactic hematoma surgery, but severe skin depression is often a postoperative complication. We report the autologous bone dust technique, which uses autogenous bone dust generated during burr hole creation to prevent cosmetic deformity.

**Patients and methods:** The autologous bone dust technique was performed for 51 sides on which burr hole surgery was conducted mainly for chronic subdural hematoma and stereotactic hematoma removal. As much bone dust as possible was collected during the burr hole creation and preserved until closure and the burr hole was plugged with the autologous bone dust. The skin depression after surgery was classified as “no or mild” or “severe” by palpating the postoperative scar. The postoperative osteogenesis was evaluated with a bone window or three-dimensional bone computed tomography (CT).

**Results:** The rate of no or mild skin depression was 86.3%. Osteogenesis in the bone window or on three-dimensional bone CT was observed in 88.6% of the cases with no or mild skin depression, whereas no osteogenesis was found in 11.4%. The rate of no or mild skin depression in patients aged greater than 82 years old (74.1%) was significantly lower than that in those aged less than 82 years old (100%).

**Conclusions:** The autologous bone dust technique is effective in preventing skin depression after one burr hole surgery without using artificial materials.

### 1. Introduction

One burr hole surgery is a common treatment modality for initial chronic subdural hematoma and stereotactic hematoma surgery, but severe skin depressions are often a complication after surgery. Some authors have reported the use of hydroxyapatite, acrylic resins, polyethylene, and ceramics for one burr hole defects [1,2]. However, these may induce a foreign-body reaction and are vulnerable to local infection.

This study aimed to report the efficacy of the autologous bone dust technique, which uses autogenous bone dust generated during burr hole creation, in preventing cosmetic deformity.

### 2. Patients and methods

This is a prospective study evaluating 48 patients who underwent burr hole surgery under local anesthesia from September 2016 to March 2018 in Shizuoka City Shimizu Hospital, Shizuoka, Japan. Closed-

system external drainage was performed in 32 cases for initial chronic subdural hematoma, and stereotactic hematoma removal was performed in 3 cases for brain hemorrhage. External drainage was extracted on the first day after surgery. Burr hole surgery was performed on 51 sides because 29 cases involved one-sided lesions and 11 cases involved bilateral lesions, excluding a case involving wound infection and 8 sides of recurrent chronic subdural hematoma. The mean age of the patients was 80.4 (49–94) years. All patients were followed up for more than six months in our outpatient clinic, and the mean follow-up period was 6.97 (6–15) months. Thirty-four of the sides were found in men and 17 sides were found in women. The skin depression after surgery was classified as either “no or mild” or “severe” by palpating the postoperative scar. The postoperative osteogenesis was evaluated more than 6 months after surgery using a bone window or bone three-dimensional computed tomography (CT). We determined the rate of no or mild skin depression and analyzed the rate of no or mild skin depression in terms of age, gender, and HbA1c.

\* Corresponding author at: Department of Neurosurgery, Shizuoka City Shimizu Hospital, 1231 Miyakami Shimizu-Ku, Shizuoka-City, Shizuoka 424-8636, Japan.  
E-mail address: [shinya3917@gmail.com](mailto:shinya3917@gmail.com) (S. Ichimura).

<https://doi.org/10.1016/j.clineuro.2018.11.019>

Received 25 August 2018; Received in revised form 22 October 2018; Accepted 25 November 2018

Available online 26 November 2018

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Fig. 1. Burr hole defect is plugged with the autologous bone dust.

2.1. Autologous bone dust technique

As much bone dust as possible was collected during the burr hole creation and preserved until closure. The diameter of the burr hole was around 20 mm. The burr hole was plugged with autologous bone dust above the absorbable gelatin sponge (Gelfoam, Pfizer, USA) to support the autologous bone dust before skin closure (Fig. 1).

2.2. Statistical analysis

The statistical difference in the data was calculated with Fischer’s exact probability test using SPSS v.22.0 (IBM Corp., Armonk, NY, USA) on a personal computer. P < 0.05 was considered significant.

3. Results (Fig. 2)

The rate of no or mild skin depression was 86.3% (44/51).Osteogenesis, as determined by a bone window or three-dimensional CT, was observed in 88.6% (39/44) (Fig. 3) of the cases with no or mild skin depression, whereas 11.4% of these cases had no osteogenesis (5/44) (Fig. 4). All cases with severe skin depression (13.7%, 7/51) showed no osteogenesis in CT (Fig. 5).All cases with osteogenesis showed no or mild skin depression.

Table 1 shows the factor for no or mild skin depression. The rate of no or mild skin depression (74.1%) in patients aged more than 82 years old is significantly lower compared to those aged less than 82 years old (100%). On the other hand, there is no statistical difference in terms of gender (female: 90.0%, male: 80.0%) and HbA1c (6.0 ≥ : 85.3%, /6.0 < : 88.2%) between these groups.

4. Discussion

Autologous bone dust confers with complete histocompatibility while possessing osteoinductive, osteoconductive, and osteogenic healing potentials [3]. Autologous bone dust is the mixture of the cancellous and cortical bone of the skull. The cancellous bone contains high concentrations of osteoblasts and osteocytes, which gives superior

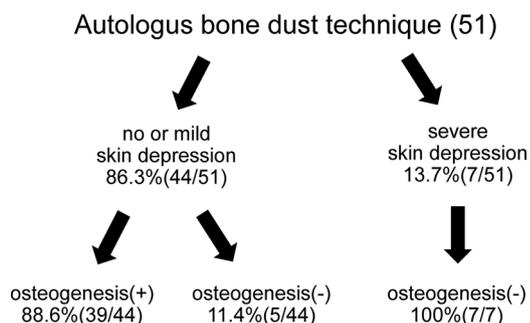


Fig. 2. No or mild skin depression was observed in 86.3% of the cases. In these cases, osteogenesis was observed in 88.6%, whereas no osteogenesis was observed in 11.4%. All cases with severe skin depression (13.7%) showed no osteogenesis.

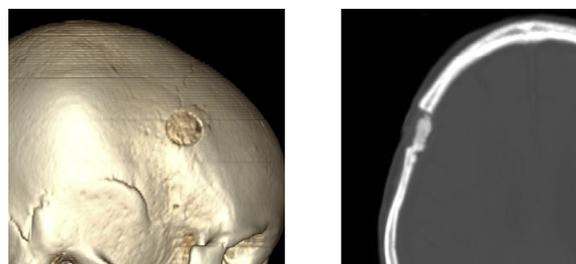


Fig. 3. No or mild skin depression with osteogenesis (39 sides). An 81-year-old man showing no skin depression after burr hole surgery of the right chronic subdural hematoma. Postoperative computed tomography showing osteogenesis in both three-dimensional bone image (left) and axial bone window (right).

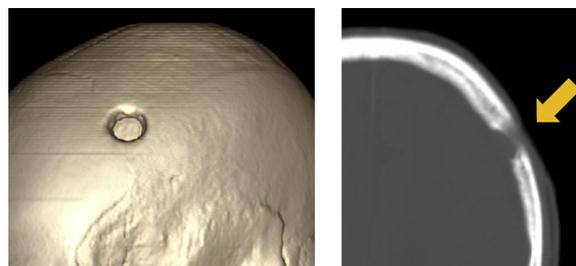


Fig. 4. No or mild skin depression without osteogenesis (5 sides). An 80-year-old man showing mild skin depression after burr hole surgery of the left chronic subdural hematoma. Postoperative computed tomography showing no osteogenesis in a three-dimensional bone image (left) but revealing fibrotic tissues in the axial bone window (right) (arrow).

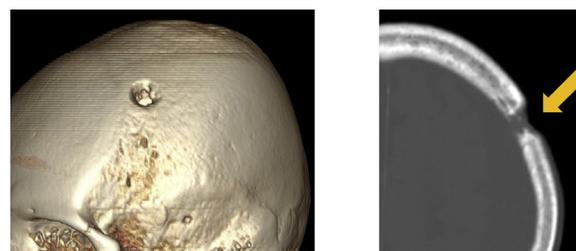


Fig. 5. Severe skin depression with osteogenesis (7 sides). A 93-year-old woman showing severe skin depression (arrow) after burr hole surgery of the left chronic subdural hematoma. Postoperative computed tomography showing no osteogenesis in both three-dimensional bone image (left) and axial bone window (right).

Table 1

Factors for no or mild skin depression.

	Age 82≥/82 <	Gender Female/Male	HbA1c 6.0≥/6.0 <
no or mild skin depression	74.1% <sup>a</sup> /100%	90.0%/80.0%	85.3%/88.2%

<sup>a</sup> Significantly lower (P < 0.05) by Fischer’s exact probability test.

osteogenic potential. Additionally, its large trabecular surface area encourages revascularization and incorporation [3,4].

Unlike the cancellous bone, the cortical bone comparatively has a limited supply of osteoblasts, osteocytes, and other cellular progenitors. This lack of cellularity results in the limited osteogenic and osteoinductive properties of cortical bone grafts [3–5]. The process by which cortical bone is incorporated is mediated predominantly by osteoclasts, as opposed to osteoblasts [3]. Given the dense organization of

cortical bone, revascularization is hampered. Overall, the cortical autograft is much slower to incorporate compared to the cancellous graft. Kubota et al indicated that the preservation of periosteum is important for calvarial remodeling because postoperative calvarium ossification requires periosteum-mediated blood supply, which is lacking after using avascular synthetic materials [6].

Skeletal aging is accompanied by decreased cancellous bone mass and increased formation of pores within the cortical bone [7]. The number of osteoclasts in the cancellous bone diminishes with age [8]. Distress signals produced by old and/or dysfunctional osteocytes are the culprits of the increased intra cortical porosity in old age [7]. Giordano et al. suggested that the osteogenic property of autologous bone graft decreases and the osteoconductive property is compromised in the elderly aged over 65 years old [9].

Even when autologous bone dust is absorbed and osteogenesis does not occur, it is thought that granulation tissue forms and becomes fibrotic due to the inflammation caused by absorbing autologous bone dust [10,11]. This is considered as a reason why severe skin depression is not observed in some patients even if autogenous bone dust is absorbed.

We did not use fibrin glue in this technique, but Matsumoto reported that the mixture of bone dust and fibrin glue allows it to be easily shaped to fit bone defects, resulting in favorable cosmetic outcomes [12]. Absorption of fibrin glue was replaced with inflammatory cells, such as osteoblasts and fibroblasts [12].

## 5. Conclusions

Autologous bone dust technique effectively prevents skin depression after one burr hole surgery without using artificial materials.

## Funding

This study has no funding.

## Declarations of interest

None.

## Conflict of interest

All authors have no conflict of interest.

## Disclosure

The authors have no personal, financial, or institutional interest in any of the materials, described in this article.

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