

Fig. 1. Displaced and overlapped oblique fracture of the manubrium sterni.

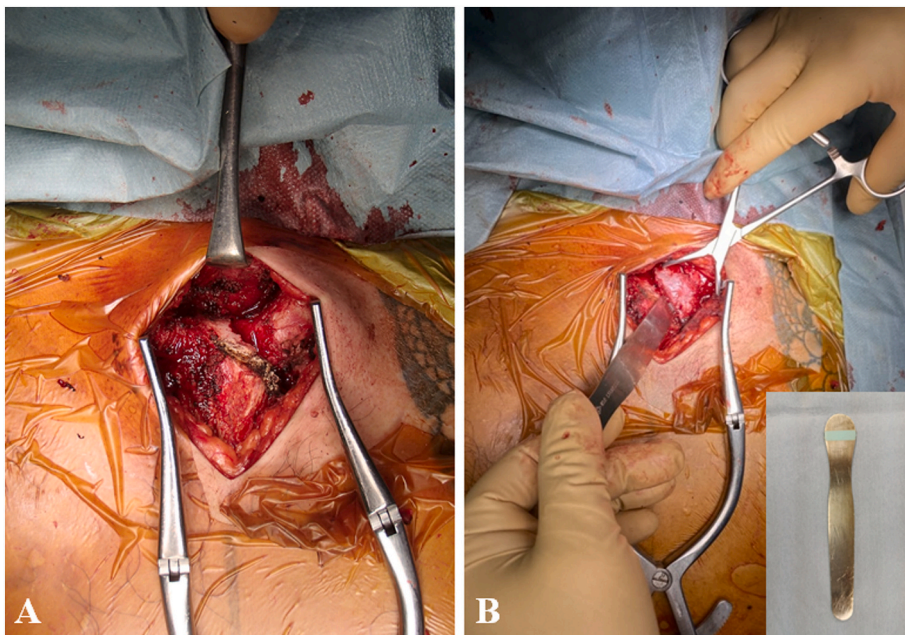


Fig. 2. A, The fracture site before reduction. B, The reduction by the bone gripping forceps, being supported by the cement spatula.



Fig. 3. A, Depth-limited drilling. B, Drilling to prevent excess drilling of opposite cortex.

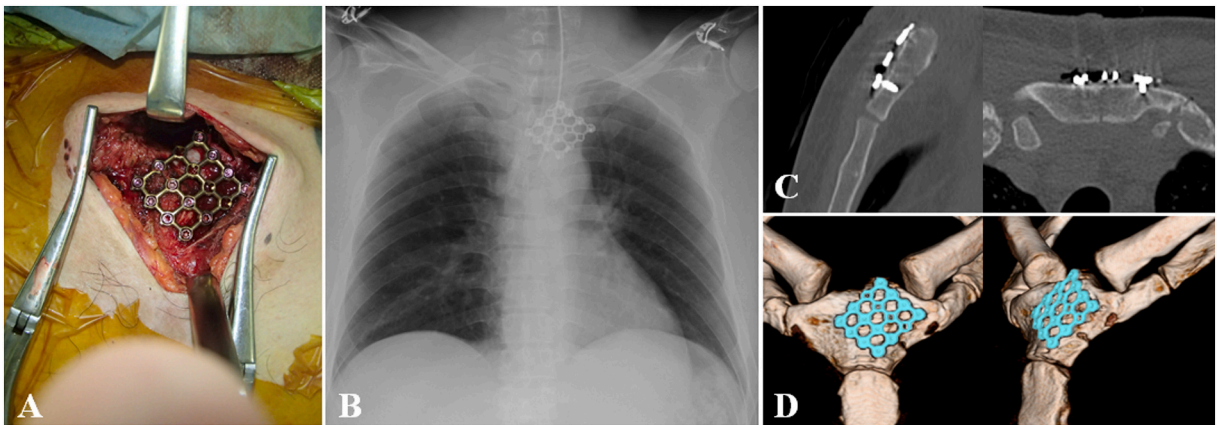


Fig. 4. A, Intraoperative picture showing how eight locking screws were placed into the large fragment and four locking screws were placed into the small fragment. B, X-ray of mesh plate location on sternum. C and D, Computed tomography (CT) and three-dimensional CT showing post-operative findings.

himself. He complained of anterior chest pain. The initial CT findings indicated displaced and overlapped oblique fractures of the manubrium sterni (Fig. 1) and fractures of the left, 1, 4, and 5, and right, 1, ribs. During preoperative planning, both orthopedic surgeons and thoracic surgeons decided to perform the operation together. On day 5 of admission, surgery was performed under general anesthesia. Thoracic surgeons expanded the operating field with a skin incision (median 6 cm) from the fossa jugularis to the angulus Ludovici. The sternum and fracture site were exposed after the pectoral muscles were dissected up to the mandibular margins. Orthopedic surgeons performed reduction and plate osteosynthesis. To ensure anatomical reduction, we removed the trapped soft tissues. We reduced the fracture site by using bone gripping forceps, which were supported by a cement spatula (Fig. 2). After reduction, internal fixation was performed using the mesh plate, which was bent anatomically. The plate was attached to the fragment using 2.4-mm locking screws. We performed depth-limited drilling to prevent excess drilling of the opposite cortex (Fig. 3). Eight locking screws were placed into the large fragment and four locking screws were placed into the small fragment (Fig. 4). We performed a layer-wise wound closure with no drainage tube. The thoracic surgeons stood by to manage and treat emergency life-threatening injuries to the mediastinum during plate osteosynthesis. The patient was discharged 3 days after surgery. At 8 months post-surgery, we confirmed bone union. The patient had no limitation in the range of motion of both shoulders and no postoperative complications.

Discussions

This is the first report to state the efficacy of plate osteosynthesis by mesh plate for treating oblique fractures of the manubrium sterni. We found that a mesh plate was effective for the plate fixation of the manubrium sterni because of its low profile, use of short size locking screws (the shortest was 6 mm), abundance of screw holes, and ease of cutting for anatomical fitting to specific fracture patterns.

With regard to the intraoperative safe technique of drilling, we emphasize the importance of depth-limited drilling in combination with the preoperative CT scan measurement of sternal thickness to reduce the risk of complications due to the operative procedure. Schulz-Drost et al. stated the importance of these measures as drilling too deep may cause life-threatening injuries to the mediastinum [1]. During reduction, the support of a cement spatula with a blunt tip was also important to reduce the risk of complications. The cement spatula also supported the bone fragment with its wide surface, to ease the reduction.

Although, in general, orthopedic surgeons are not unfamiliar with operations near the mediastinal organs, nor thoracic surgeons with fracture reduction and plating techniques, many surgeons are unwilling to perform sternal osteosynthesis because of the risk of severe injuries to mediastinal organs and lack of experience. In the present case, preoperative planning was performed by both surgery teams together. We therefore emphasize the importance of teamwork beyond the borders of department specialties.

In conclusion, our positive experience with the operative treatment using a mesh plate may help to establish the operative procedure of first choice in cases of manubrium sterni fracture.

Declaration of competing interest

The authors declare that there are no conflicts of interest.

Acknowledgements

We would like to take this opportunity to thank Kunio Narita and Yuji Nomata for useful discussions and to thank Ichiro Takeda for advice.

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