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Case Series

A new surgical approach for the treatment of scapular glenoid fractures-Axillary approach: A single center case series

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A R T I C L E I N F O

Keywords:
Axillary approach
Scapular glenoid fractures
Efficacy
Retrospective study

A B S T R A C T

Background: The purpose of this study was to assess the efficacy of the scapular glenoid fractures by a new surgical approach (Axillary approach) through follow-up studies.
Method: We retrospectively analyzed the prospectively collected data from 11cases of glenoid fractures were treated by open reduction and internal fixation through a Axillary approach approach between July 2019 and October 2020. All patients were required to conform to regular follow up postoperatively. X-ray film and CT scan was applied to all cases. The Constant score system, the UCLA score system and DASH score system were used to evaluate functional results.
Results: All patients achieved bone union. At the final follow-up, the mean Constant score was 92.5 ± 3.0 (range 85–97) points and the mean UCLA score was 33.5 ± 1.6 (range 31–36) points. According to the UCLA score system, two patients achieved excellent results and one patients had good results. The mean DASH scores were 7.7 ± 3.2 (range 4–12). Compared with the preoperative functional score, it was significantly improved ($P < 0.01$).
Conclusions: The axillary approach as a new method for scapular glenoid fractures (especially the fracture of the lower half of the scapular glenoid) has achieved desired results, and it can provide new options for clinical treatment.
Level of evidence: Level III; Development or Validation of Outcome Instrument

1. Introduction

Scapular glenoid fracture involves the articular surface of the scapular glenoid, which is usually caused by violence [1]. The incidence of scapular glenoid fractures is not high. It only accounts for 10% of scapula fractures, and scapula fractures only account for 3%–5% of upper limb fractures [2]. Although scapular glenoid fractures are not common, they are tricky to deal with for doctors. Improper treatment can seriously affect the function of the shoulder joint. For the treatment of this fracture involving the articular surface, we often resort to surgery [3,4]. The most common operation is open reduction and internal fixation (ORIF), followed by arthroscopic repair [5]. ORIF have large wounds, which can easily cause damage to the muscles and ligaments around the joints. Arthroscopic repair is minimally invasive 6, but there are few indications. The range of options for internal fixation materials is limited, which cannot meet the requirements of various types of fractures. We used the axillary approach in the treatment of scapular glenoid fractures, which can effectively improve the minimally invasiveness of ORIF. At the same time, the fixation is firmer and the indications are wider compared with arthroscopic surgery. After postoperative follow-up, the treatment effect was excellent and worthy of clinical application.

2. Patients and methods

2.1. Patients

We retrospectively analyzed the prospectively collected data from 11 cases of glenoid fractures were treated by open reduction and internal fixation through a Axillary approach between July 2019 and October 2020 at our institute. Scapular glenoid fracture was classified using the Ideberg classification system [6]. The inclusion criteria for the

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research were as follows: (1) Scapular glenoid fracture (type I and type II) determined according to the classification described by Ideberg et al.; (2) acute, no more than 14 days of trauma; (3) no history of scapular glenoid fracture or other shoulder trauma; (4) no previous surgery on the shoulder. The exclusion criteria were as follows: (1) other types (type III, type IV, typeV and typeVI); (2) no signed informed consent. The research protocol was approved by the Institutional Review Board of the authors' institute. Written informed consent was obtained from all of the participants, and the research methods were carried out in accordance with approved guidelines. The work has been reported in line with the PROCESS criteria [7].

2.2. Surgical procedure

After general anesthesia, the patient was in lateral recumbent position. The surgeon completed the pre-operative preparations. The chief surgeon was located on the back of the patient. The shoulder joint of the patient was abducted extremely. The incision started from the upper anterior edge of the axillary fold and extended downward along the anterior edge of the latissimus dorsi. The total length was about 6–8 cm (Figs. 1 and 2). During the operation, we first needed to identify the latissimus dorsi. When the shoulder joint was abducted, it was easy to touch the front edge of the latissimus dorsi. After opening the skin and subcutaneous tissue along the front edge of the latissimus dorsi, we would see the tendons of the latissimus dorsi. Next, we should use our fingers to gently separate the fascia along the latissimus dorsi. At the same time, by moving the affected limb passively to determine the junction between the humeral head and the scapular glenoid. We would touch the stripe-like findings on the active area of the humeral head by sliding up and down with our fingers. The cord-like objects were the axillary nerve and posterior circumflex artery, which need to be protected during the operation (Fig. 3). Continue to separate downward, we would reach the subscapular artery and the circumflex scapular artery. The subscapular artery might not need to be exposed during the operation, and the circumflex scapular artery would be separated about 3 cm below the axillary nerve. When we pulled the latissimus dorsi back and the rotator scapular artery forward, the lateral edge of the scapula, the head of the humerus and the joint capsule would be clearly exposed. In the next step, we would easily detect the fracture involving the lower part of articular surface of the scapular glenoid (Fig. 4), and fix it with mini-locking plates and hollow lag screws after reduction.

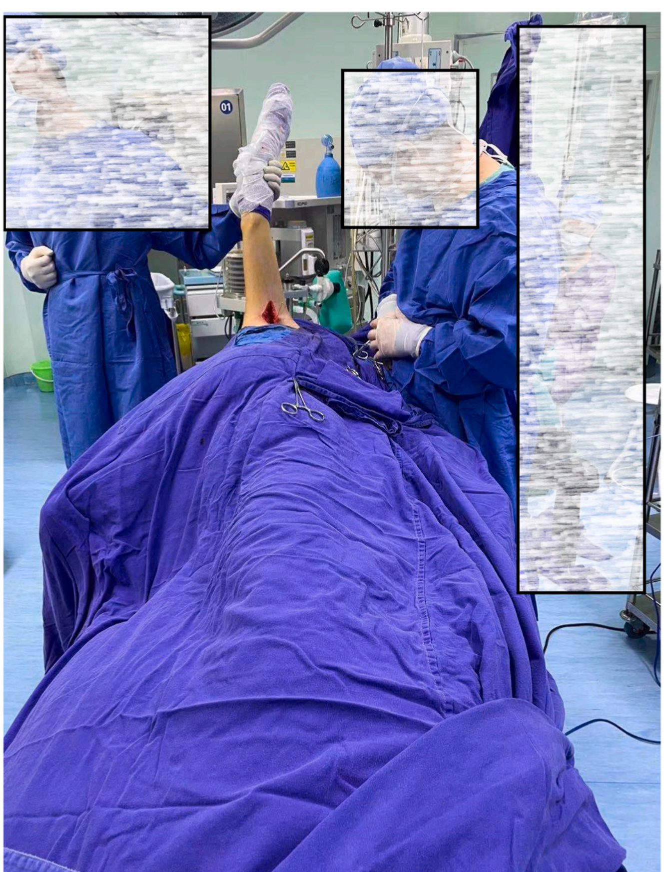

Fig. 1. Patient's surgical posture.

Fig. 2. Patient's surgical incision.

2.3. Clinical evaluation

All cases were regularly followed up after surgery as required. Anteroposterior and lateral radiographs were required to be photographed to assess the condition of scapular glenoid fracture during follow-up. Constant-Murley criteria, the UCLA score system and the DASH scores were used to evaluate the postoperative functional status of patients.

2.4. Statistics

Means and standard deviations (SDs) were used to describe all numerical data. Paired *t*-test was used to compare preoperative and postoperative functional score. Values of 0.05 represent a statistically significant difference. Analyses were performed using SPSS version 21 (IBM).

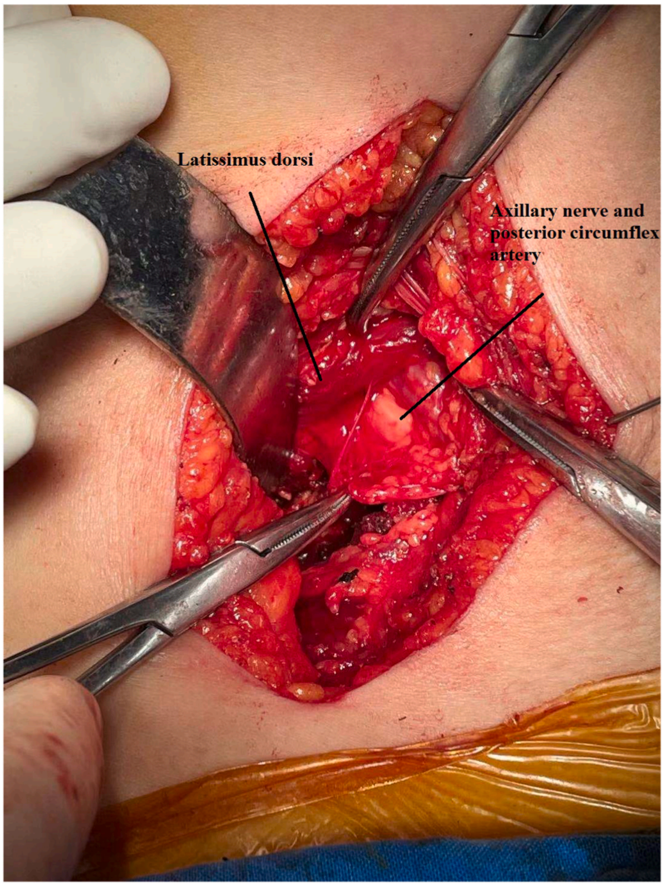

Fig. 3. Important tissue structure in the incision.

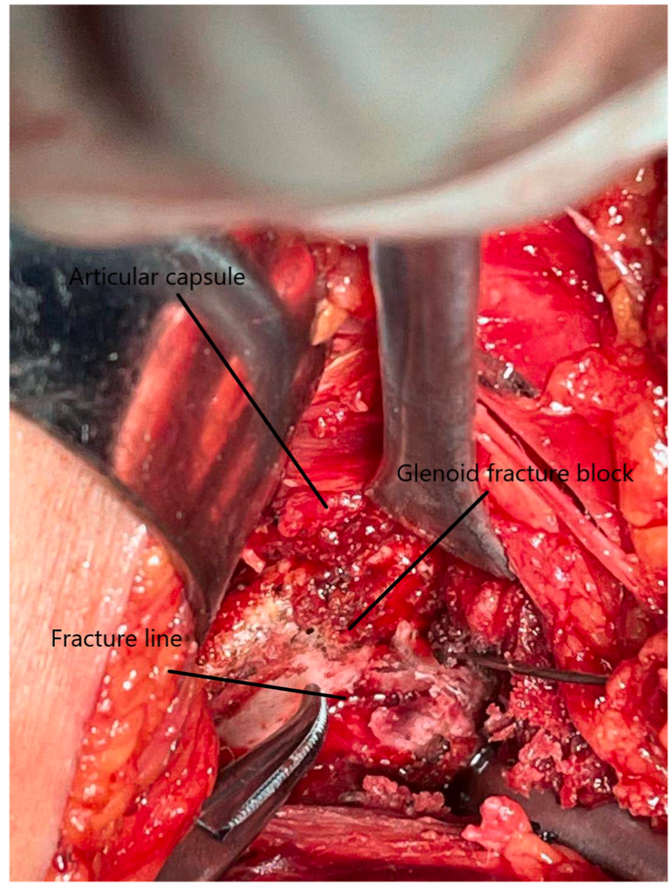

Fig. 4. Exposure diagram of glenoid fracture block.

3. Results

All patients were followed up at an average of 13.2 ± 1.6 (range 12–15) months (Table 1). The left shoulders were involved in 5 cases and right in 6 cases. All cases injured by a fall from a height. In addition to X-ray film, CT scan was applied to all cases. According to Ideberg classification system, there were 7 cases classified as type I I and 4 cases as type Ia. The mean time from injury to surgery was 5.0 ± 1.7 days.

All patients achieved bone union. No axillary nerve paralysis occurred. Neither superficial nor deep infections were observed in this series. At the final follow-up, the mean forward flexion of the affected shoulders was 153.5 ± 6.7° (range 149°–168°). The mean abduction of the affected shoulders was 165.5 ± 6.7° (range 134°–178°). The mean external rotation was 56.4 ± 6.5° (range 49°–71°). The internal rotation that presented as the level the thumb in extension can reach was T12, T10, and T8 in one case, respectively. The mean Constant score was 92.5 ± 3.0 (range 85–97) points and the mean UCLA score was 33.5 ± 1.6 (range 31–36) points at the last follow-up. According to the UCLA score system, 9 patients achieved excellent results and 2 patients had good results. The mean DASH scores were 7.7 ± 3.2 (range 4–12). Compared with the preoperative functional score, it was significantly improved ($P < 0.01$) (Table 2). Hardware failure was not observed in this series (Fig. 5).

4. Discussion

There are various surgical approaches for scapular glenoid fractures. Conventional surgical approaches in clinical applications include: 1. Anterior approach (intermuscular groove approach), which is suitable for anterior or lower glenoid fractures; 2. The posterior approach, which is the surgical approach for treating scapular glenoid, neck and body fractures, including the Judet approach and the modified Judet approach [8]; 3. The Posterior and superior approach is suitable for the treatment of acromion, upper part of the glenoid or central transverse fractures [8–10]. In the actual operation, we found that the ligaments and tendons around the shoulder joint were invaded greatly during the operation, whether it was through the intermuscular groove approach or the Judet approach [11,12]. In the treatment of scapular glenoid fractures, the intermuscular groove approach requires incision of the subscapularis tendon, and the Judet approach requires the stripping of the subscapular muscle, which causes great trauma to the soft tissues around the shoulder joint [13]. Is there a new surgical approach to solve or partially solve the above-mentioned problems? The approach must meet the principle of proximity, which is to perform surgery at the site closest to the lesion or the site that needs to be exposed. The second is to meet the principle of minimally invasiveness and minimize damage to the important arteries and stable structures of the scapula. Inspired by Professor Yun Tian and Professor Dankai Wu of China, the axillary approach may be a new surgical approach for the treatment of scapular glenoid fractures, especially suitable for fractures involving the lower half of the glenoid.

This surgical approach has little interference with surrounding muscles and ligaments. It can clearly reveal the glenoid, scapular neck, and lateral edge of the scapula. At the same time, the incision can be appropriately extended as needed. The important neurovascular bundles in the shoulder joint are all located in front of the joint and the tissues in the armpits are soft. It is easy to stretch the soft tissues during the operation to reveal the surgical field of vision. In actual operation, it is necessary to protect some surrounding blood vessels and nerves. The first is the axillary nerve. Under normal circumstances, the axillary nerve is often located above the glenoid and passes less than 1 cm above the joint capsule area. In the case of extreme retraction during the

Table 1
Case information.

	Gender	Age (years)	Fracture type	Follow up time (months	Functional score at the last follow-up		
					Constant-Murley score	UCLA score	DASH score
Case 1	Male	65	type I I	13	95	32	6
Case 2	Female	48	type I I	12	96	33	7
Case 3	Female	54	type I I	12	97	34	4
Case 4	Male	53	type Ia	12	85	35	11
Case 5	Male	43	type I I	13	91	36	8
Case 6	Male	46	type Ia	13	88	31	10
Case 7	Female	38	type I I	15	96	33	5
Case 8	Female	63	type Ia	13	90	34	12
Case 9	Male	42	type I I	15	95	35	7
Case 10	Male	39	type Ia	13	93	32	6
Case 11	Female	66	type I I	15	92	34	9

Table 2
Functional score.

	Preoperative	Last follow-up	T	P
Constant scores	35.2 ± 2.5	92.5 ± 3.0	$t = -8.6$	$P < 0.001$
UCLA scores	7.1 ± 1.2	33.5 ± 1.6	$t = -3.3$	$P = 0.004$
DASH scores	86.3 ± 4.8	7.7 ± 3.2	$t = -7.6$	$P < 0.001$

operation, the distance is about 2 cm. The fingers can touch the cord-like objects, which are often accompanied by the posterior circumflex artery, and we need to protect them carefully during the operation. Second is the circumflex scapular artery, which can be separated and dissected about 3 cm below the axillary nerve. In our case, the exposure and protection of these three nerves and blood vessels has basically met the needs of the operation. There is no need to continue dissecting and separating other nerves and blood vessels to perform fracture reduction and internal fixation. We pull the latissimus dorsi muscle to the back and the rotator scapular artery to the front to expose the lateral edge of the scapula, the head of the humerus and the joint capsule. After the exposure is clear and complete, the glenoid fracture can be reliably reduced and fixed. If the outer edge of the scapula needs to be processed, the incision can continue to be extended downward. Based on the experience of Professor Yun Tian and Professor Dankai Wu, the entire lateral edge of the scapula and the subscapular angle can be exposed. When we extend the incision, the subscapular artery and thoracic dorsal artery need to be separated and exposed. At this time, the axillary lymph nodes are in front of the operation area, and the entire operation area is on the posterior side of the axilla. The upper edge of the operation area is the axillary nerve and posterior circumflex artery. Its anterior edge is the subscapular artery, the lower edge is the circumflex scapular artery and the posterior edge is the latissimus dorsi tendon and scapula. Through this area, we can clearly see the humeral head, scapular neck, joint capsule, scapular glenoid and the upper 1/3 of the lateral edge of the scapula. Even we can touch the coracoid process through the deep separation of the anterior scapula. If we continue to extend the incision downward, the subscapular angle and the entire lateral edge of the scapula can be exposed. At this time, the anterior edge of the operation area is the thoracic dorsal artery, the upper edge is the scapular circumflex artery, and the posterior edge is the latissimus dorsi and scapula.

Ideberg type I and type I I fractures usually have a complete joint capsule. If the joint capsule is torn, it can be sutured directly. If the joint capsule is torn, it can be sutured directly. After the fracture is reduced, the Kirschner wire is temporarily fixed, and then firmly fixed with a steel plate. The fracture is basically anatomically reduced according to our experience. If the articular surface is severely pulverized, it needs to be reduced under direct vision. Intraoperative T-shaped incision of the shoulder joint capsule can be used to expose the humeral head and glenoid. Reduce the fracture under direct vision to confirm the flatness of the articular surface. Although our case only involves glenoid fractures, theoretically the indications for axillary approach can be extended to fractures involving the body of the scapula and the glenoid neck, bone reconstruction and repair of habitual dislocations, etc. From the follow-up results, the functional recovery of patients after axillary approach is excellent, which is worthy of our clinical promotion.

4.1. Strengths and limitations

In this study, a new surgical approach was used to treat scapular glenoid fractures, which made up for the shortcomings of the original surgical approaches and provided a new method for the treatment of scapular glenoid fractures. However, the number of cases treated in this study is small, and the sample size needs to be expanded for further research and observation. Secondly, the main types of cases studied are Ideberg type I and type I I. The relative types are relatively limited. Thirdly, this approach involves the axillary nerve, which is easy to be damaged during operation. Finally, we found that straight incisions in the armpits can easily cause scar contractures and affect shoulder joint abduction, so z-shaped incisions can be used instead.

5. Conclusions

The axillary approach as a new method for scapular glenoid fractures (especially the fracture of the lower half of the scapular glenoid) has achieved desired results, and it can provide new options for clinical treatment.

Availability of data and material

All data generated or analyzed during this study are included in this published article.

Ethical approval

The Committee on Research Ethics of the Ningbo No.6 hospital approved the study and the research methods were carried out in accordance with approved guidelines. Judgement's reference number: L2021073.

Sources of funding

No.

Author contribution

DX provided major contributions to writing and editing the manuscript. WGL and ML participated in the design of the study and performed the statistical analysis. JMC supervised the writing of the manuscript. WGL interpreted the radiologic results. All authors read and approved the final manuscript.

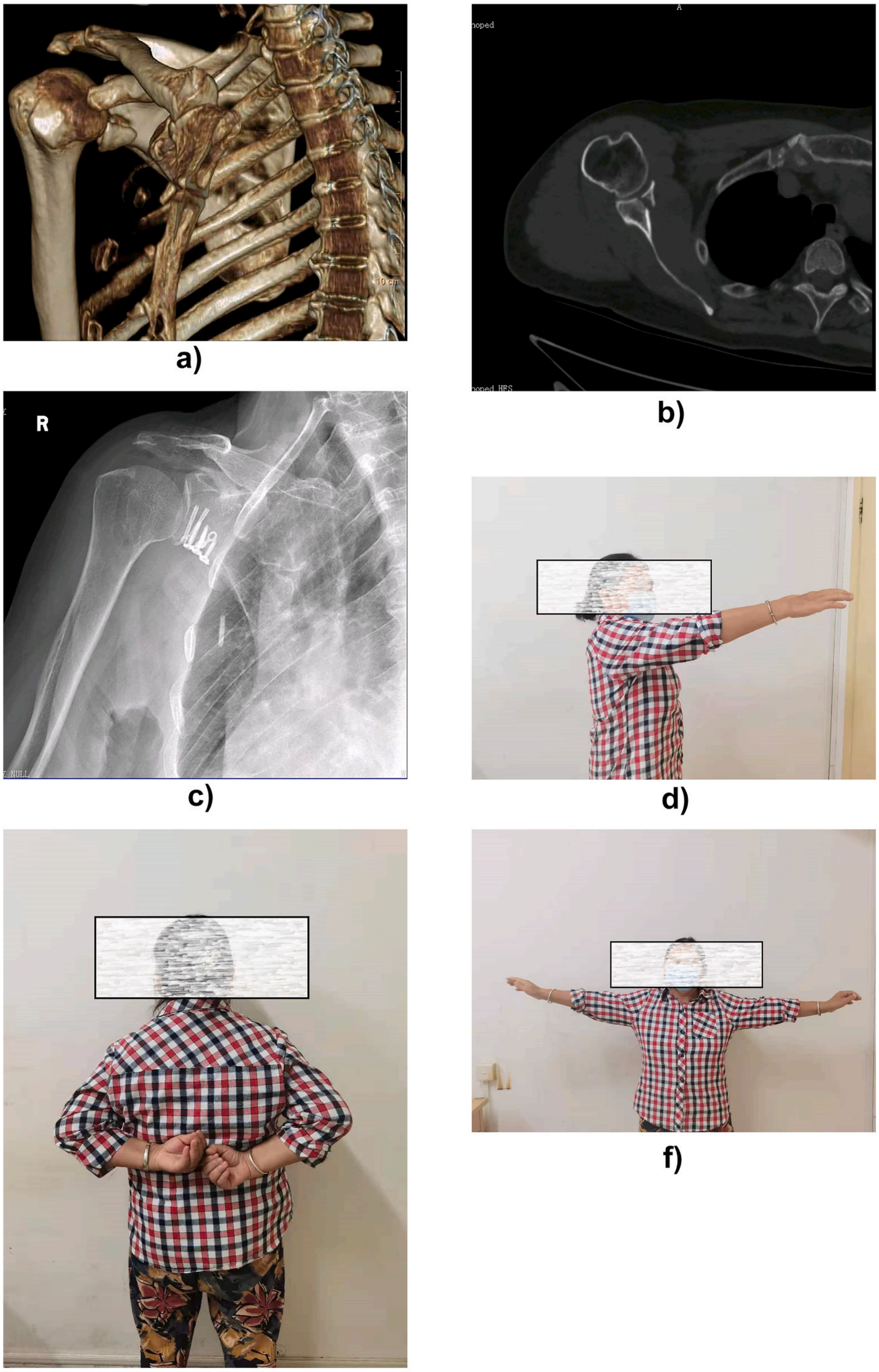

Fig. 5. A 54-year-old woman injured by a fall, resulting in an Idberg type II glenoid fracture. Preoperative three-dimensional tomography scans (a, b) showing the fracture line that runs from the fossa to the lateral border of the scapular body. The lower part of the scapular glenoid articular surface is displaced. X-rays re-examined 12 months after surgery (c) showing that the articular surface of the glenoid was flat and the microplate and hollow lag screws were firmly fixed. The fracture had healed. Re-examination of the affected limb function during the 12-month follow-up after the operation showing excellent recovery (d,e,f).

Trial resigester number

1. Name of the registry:

   Chinese clinical trial registry.

2. Unique Identifying number or registration ID:

   ChiCTR2200056958.

3. Hyperlink to your specific registration (must be publicly accessible and will be checked):

   http://www.chictr.org.cn/showproj.aspx?proj=153271.

Guarantor

Ding Xu.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104029.

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