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# The time point in surgical excision of heterotopic ossification of post-traumatic stiff elbow: recommendation for early excision followed by early exercise

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**Background:** Post-traumatic heterotopic ossification (HO) around the elbow may severely impair joint function. Although surgical excision is effective at restoring range of motion (ROM), traditional surgical treatment is postponed for at least 1 year to prevent recurrence, which leads to secondary contracture of the elbow. Because the optimal timing of resection is controversial, our study was performed to compare recurrence and elbow function between early and late excision in our patients to determine whether the delay is necessary.

**Methods:** We retrospectively reviewed 164 patients during a 4-year period. In the control group (112 patients), HO was excised at an average of 23.0 months after initial injury (range, 9-204 months); in the early excision group (52 patients), resection was performed at an average of 6.1 months (range, 3-8 months). HO recurrence was assessed by the Hastings classification system. Final ROM and Mayo Elbow Performance Scores were also evaluated.

**Results:** Recurrent HO was observed in 30 of 112 patients (26.8%) in the control group and 15 of 52 (28.9%) in early excision group. No significant difference in HO recurrence was found between the 2 groups ( $P = .942$ ). Moreover, there were no notable differences regarding ROM, Mayo Elbow Performance Scores, and complications postoperatively.

**Conclusions:** Early excision associated with early exercise is effective for the treatment of HO aiming at a low recurrence rate and satisfactory function. The conventional surgical delay of more than 1 year may be shortened.

**Level of evidence:** Level III, Retrospective Cohort Design, Treatment Study.

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**Keywords:** Post-traumatic heterotopic ossification; elbow stiffness; time point; early excision; surgical excision

Shuai Chen and Shi-yang Yu are co-first authors.  
This study was approved by the ethical committee of Shanghai Sixth People's Hospital (study number DYLL-201501).

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Heterotopic ossification (HO), which is the formation of bone in the periarticular soft tissues, is a poorly investigated sequela after trauma, brain injury, burns, or surgery.<sup>9,10,31</sup> The most frequently involved joints are the hip, elbow, and knee.<sup>8,19,32</sup> The specific pathogenesis of this phenomenon, which is still unclear, needs to be further studied.

HO that develops around the elbow may lead to compromised range of motion (ROM) and even a total loss of movement.<sup>13,31</sup> Direct trauma is reported to be the most common cause of HO around the elbow.<sup>17,40</sup> The impairment in ROM that leads to stiffness of the elbow may greatly limit daily activities, which require an arc of motion of 100° (from 30° to 130°).<sup>3,6,9,15,35,44</sup> If nonoperative management fails to achieve functional ROM, surgery is necessary to restore elbow function.<sup>2,7,11,15,21,28,37,42,45</sup>

However, with a high incidence of recurrence, surgical excision of HO is usually delayed for 12 to 24 months (from injury to operation) until the maturation of bone occurs.<sup>1,4,14,18,20,22,30,31,34,36,38,39,41,43</sup> During this period, the function of the elbow is significantly impaired by secondary contracture.<sup>12,23,29,34,41</sup> Furthermore, less satisfactory function can be expected after excision because of soft tissue contracture and muscular atrophy.<sup>41</sup> Because the optimal time point of surgical excision has not been confirmed yet, our study was performed to compare recurrence rates and elbow function between early and late excision in our patients to establish the optimal timing for excision.

## Methods

### Patients

In this retrospective case-control study, all patients who were treated for a stiff elbow at our institution from January 2010 to January 2014 were retrospectively reviewed. The inclusion criteria included (1) patients who underwent HO excision of a post-traumatic stiff elbow, (2) HO visible on preoperative radiographs and confirmed during the operation, (3) age of 18 years or older, (4) radiographic evidence of bone union in elbow fracture patients, (5) elbow stability confirmed by physical examination in elbow dislocation patients, and (6) serum alkaline phosphatase levels within the normal range. The exclusion criteria included (1) patients who had previously undergone surgery to resect HO of the involved elbow; (2) HO caused by a burn, brain injury, or congenital disease; and (3) patients with a history of trauma and limited ROM in the involved elbow before injury. All the operations were performed by the senior author (C.-y.F.). Plain radiographs and computed tomography with 3-dimensional reconstruction were routinely obtained to assess the extent and localization of HO.

Patient demographic data (gender, age, and follow-up time), pathogeneses, surgical approaches, and postoperative joint infections and hematomas are listed in Table I. No significant differences were found in these data. The average time from initial injury to HO excision in all patients ranged from 3 to 204 months. Early excision, which was defined as excision performed at less

than 8 months, achieved satisfactory outcomes in the literature.<sup>31,34</sup> Thus, we established this as our time limit to define early versus late surgical resection. Fifty-two patients underwent early resection at an average of 6.1 months (range, 3-8 months) and comprised the early excision group. One hundred twelve patients underwent surgery at more than 8 months for their own reasons and comprised the control group. In this group, resection was performed at an average of 23.0 months (range, 9-204 months).

### Preoperative evaluation

The classification of elbow HO was based on the Hastings classification system,<sup>22</sup> which classifies patients according to the plane (or planes) of elbow stiffness: grade I, radiographically evident HO formation without functional limitation (defined as flexion-extension <30° to 130° and/or pronation-supination <50° to 50°)<sup>35</sup>; grade IIA, HO with limited flexion/extension; grade IIB, HO with limited pronation/supination; grade IIC, HO with limited flexion/extension and pronation/supination; grade IIIA, HO with ankylosis of the flexion-extension plane; grade IIIB, HO with ankylosis of the pronation-supination plane; and grade IIIC, HO with ankylosis of both the flexion-extension and pronation-supination planes. According to this classification, no significant difference was seen in the preoperative incidence of HO, as shown in Table II. ROM was measured with a handheld goniometer. There was also no notable difference in preoperative ROM between the 2 groups (Table III).

### Postoperative exercise

On the first postoperative day, patients began cycle exercises of flexion and extension, including active and passive elbow motion, under our supervision. Exercises were performed for a half hour 3 times a day during the first week; the length of each session was gradually extended to 1 hour. Patients were encouraged to participate in the rehabilitation protocol until at least 3 months postoperatively. To prevent HO, indomethacin (25 mg) was taken 3 times a day for 4 weeks by all patients. No radiotherapy was used in any patients.

### Statistical analysis

The categorical variables were compared by 2-tailed Fisher exact test. An independent-samples *t* test was used for ROM and the Mayo Elbow Performance Score (MEPS). A *P* value of .05 was used to determine statistical significance (SPSS Statistics, version 22; IBM, Armonk, NY, USA).

## Results

### HO recurrence

This study included 164 patients who met the inclusion criteria and achieved satisfactory follow-up. These patients were divided into 2 groups according to the timing of excision. The control group was composed of 112 patients who underwent HO excision after more than 8 months, with a mean follow-up of 15 months (range, 10-22 months). The

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