

学位論文の要旨

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学位論文名 Effect of Ageing on Healing of
Bilateral Mandibular Condyle Fractures in a Rat Model

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論文内容の要旨

INTRODUCTION

The mandibular condyle is frequent site of maxillofacial fracture. The management of condylar fracture is important to restored mandibular ramus height by an open reduction. In children in particular, conservative treatment is usually advocated because surgical treatment of condylar fracture tends to cause growth disturbances rather than eliminate them. In a previous study of unilateral mandibular condylar fracture rats revealed that the conservative treatment could be feasible in child unilateral condylar fracture. However, there have been no detailed experimental studies on the healing of bilateral condylar fracture. In an effort to explore the feasibility of conservative treatment of dislocated bilateral condylar fracture in a younger clinical population, this study aimed to elucidate the effect of ageing on condylar remodelling after experimental bilateral condylar fracture in rats.

MATERIALS AND METHODS

Male Sprague-Dawley rats aged 3, 6, and 36 weeks old (n = 25/cohort, total n = 75) were divided a fracture group (n = 12) and sham control group (n = 12), with 1 rat from each cohort used as a normal unoperated control.

Surgical procedures In the fracture group, a 1-cm incision was made over the mandibular

angle parallel to the inferior border of the mandible on each side under general anesthesia. The bilateral condylar neck was performed horizontal osteotomy at lowest level of the sigmoid notch. In the sham control group, the condylar neck was exposed in the same manner and the wound was closed.

Tissue preparation The control rats were killed immediately, while the fracture and sham control groups were prepared for microscopic evaluation at 1, 2, 4, and 8 weeks (n = 3/week) after fracture. All sections were dehydrated in a graded series of ethanol and processed for routine paraffin embedding. Four-micron-thick, coronal, midcondylar sections were cut. Routine haematoxylin-eosin (HE) staining was done on the first section, and the second section was stained with Azan.

Immunohistochemistry Cell proliferation was evaluated by the bromodeoxyuridine (BrdU) labelling index (LI). Osteochondrogenesis was assessed by the expression of Indian hedgehog (Ihh), type X collagen, and osteocalcin in the condylar head.

Quantitative analysis BrdU-labelled and non-labelled cells in the intermediate cell layers of both condyles in the fracture and sham control groups were counted with the aid of a squared eyepiece graticule at a magnification of 400×. For each animal, four coronal mid-condylar sections were prepared and at least 1,000 cells per section were counted to obtain the average LI (labelled cells/total cells counted × 100%).

The number of Ihh-positive cells was also counted in a zone of flattened chondrocytes or a zone of hypertrophic chondrocytes by the same method as for the BrdU-labelled cells.

RESULTS AND DISCUSSION

Post operation, in 3- and 6-week-old rats, mean body weight continued to increase both the fracture and sham groups. In 36-week-old rats, body weight decreased in both the fracture and sham groups from immediately to postoperative week 1, then gradually increased in both groups.

In histological findings, at postoperative week 1, the condylar fragment was deviated and hypertrophy of the condylar cartilage was clearly apparent in all age cohorts. In 3-week-old rats, at postoperative week 2, the condylar fragment had returned to its normal position. At postoperative week 4, the segmental gap was bridged and the characteristics of the condyle were normal. In 6-week-old rats, at postoperative week 2, the condylar fragment was still deviated and

boney gap was observed. At postoperative week 4, union by immature bone trabeculae was observed and the condylar process was centralized. At postoperative week 8, the normal characteristics of the condyle and condylar process were well preserved. In 36-week-old rats, at postoperative week 2, part of the condylar fragment was absorbed and deformity of the condylar cartilage. At postoperative week 4, the displacement of the condylar fragment and diastasis of the fracture edge were observed. However the condylar process had been formed in the direction of median of temporal fossa. At postoperative week 8, the condylar process was repositioned in the temporal fossa.

BrdU LI values in the fracture groups recovered by 45.8% in 3-week-old rats, 36.0% in 6-week-old rats, and 17.9% in 36-week-old rats at 8 weeks after fracture. The number of Ihh-positive cells in the fracture groups significantly increased up to 2 weeks after fracture, then gradually decreased until 8 weeks after fracture.

In the fracture groups, except for weak type X collagen expression at postoperative week 1 in 6-week-old rats, the findings were similar to those of the 3- and 6-week-old rats in the sham control groups. In 36-week-old rats, weak type X collagen expression was seen at postoperative week 2 and 4.

Regarding the expression of osteocalcin, in the fracture groups, there were no osteocalcin-positive cells in the marrow until expression similar to the sham control groups at postoperative week 4 and 8 was seen in the 3- and 6-week-old rats. In 36-week-old rats, expression was invariant over time.

In all age cohorts, bilateral condylar fractures were restored by conservative treatment, but healing was delayed by ageing. BrdU LI values in the fracture groups were higher in younger rats at 8 weeks after fracture. The results of Ihh, type X collagen and osteocalcin expression indicated that osteochondrogenesis in the condyles recovered immediately after fracture in younger rats. Thus, the younger an animal with bilateral mandibular condylar fracture, the more satisfactory the TMJ condition without surgical treatment, but functional issues regarding ramus height and its consequences on occlusion have not been tested in this study.

CONCLUSION

The findings of this study support the clinical concept of conservative treatment of bilateral condylar fractures in younger patients.