

Characteristic Multidetector Computed Tomography Findings of
Maxillofacial Fractures Resulting from Falls in the Elderly

(高齢者転倒による顔面骨折の特徴的マルチスライス CT 所見)

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Abstract

The purpose of this study was to investigate the characteristic multidetector computed tomography (MDCT) findings of maxillofacial fractures resulting from falls in the elderly. A prospective study was performed in 38 patients over 64 years of age with maxillofacial fractures resulting from falls underwent 64-MDCT. Maxillofacial fractures were classified into eight types: mandibular median, paramedian, angle, condylar, Le Fort (I-III), isolated anterior maxillary, isolated zygomatic arch and zygomaticomaxillary complex. Statistical analysis of the relationship between gender and maxillofacial fracture locations was performed using χ^2 test with Fisher's exact test. A P value less than 0.05 was considered statistically significant. The prevalence of male and female were 40.7% and 59.3% of condylar type ($p = 0.288$), and 80.0 % and 20.0 % of zygomaticomaxillary complex type ($p = 0.170$), respectively. In conclusion, regarding to elderly patients, the condylar type was considered more frequency in female with maxillofacial fractures resulting from falls, and the zygomaticomaxillary complex type was considered more frequency in male with those.

Introduction

Maxillofacial fractures in elderly patients are less frequent and are mostly related to age-related changes and systemic pathologic conditions, although the incidence, etiology, and pattern geographic area and socioeconomic status (1-3). In recent years, however, traumatic injuries in the elderly have been increasing because of the prolonged life span with progress in medicine, resulting in a greater percentage of older people in the population, with a more active lifestyle (4, 5).

Falls are frequent cause of trauma, especially in the elderly, causing disability, morbidity and increased health care utilization (6, 7). Maxillofacial bones support functions such as breathing, smelling, seeing, speaking, and eating (8). Therefore, maxillofacial fractures require accurate radiologic diagnosis and surgical management to prevent severe functional debilities and cosmetic deformity. Fracture morphology of maxillofacial trauma is often complex, the radiologist should be familiar with the imaging findings.

Multidetector computed tomography (MDCT) with multiplanar reformation (MPR) and three-dimensional (3D) images has become a standard part of the assessment of facial injury because of the exquisite sensitivity of this imaging technique for fracture (9-12). However, to our knowledge, characteristic MDCT findings of maxillofacial fractures resulting from falls in the elderly have not been reported in the literature.

The purpose of this study was to investigate the characteristic MDCT findings of maxillofacial fractures resulting from falls in the elderly.

Materials and Methods

Patient Population

This prospective study was approved by the ethics committee of our institution (No. EC10-039). After obtaining written informed consents, 38 patients over 64 years of age (18 males, 20 females; age 65-87 years, mean age 73.7 years) with maxillofacial fractures resulting from falls underwent 64-MDCT within 7 days after injury at our university hospital from April 2006 to December 2012.

Image Acquisition

CT imaging was performed with a 64-MDCT (Aquilion 64, Toshiba Medical Systems, Tokyo, Japan) using the maxillofacial trauma protocol at our hospital: tube voltage, 120 kV; tube current, 100 mA; field of view, 240 mm × 240 mm; rotation time, 1.0 s; mean effective dose, 1.8 mSv; mean CTDI_{vol} value, 32.0 mGy; mean DLP value, 595.1 mGy cm. In this study, the k factor used is the head-neck factor 0.0031 mSv/(mGy cm). The reference for the used conversion factor is International Commission on Radiological Protection (ICRP) publication 102, Table A2 (13). The protocol consisted of axial acquisition (0.50 mm) with axial (3.0 mm), coronal (3.0 mm) and sagittal (3.0 mm) MPR and 3D images.

Image Analysis

The MDCT images were independently evaluated by two oral and maxillofacial radiologists and

any discrepancies were resolved by forced consensus. Maxillofacial fractures were classified into eight types: mandibular median, paramedian, angle, condylar, Le Fort (I-III), isolated anterior maxillary, isolated zygomatic arch and zygomaticomaxillary complex type (14).

Statistical Analysis

Statistical analysis for the relationship between gender and location of maxillofacial fracture was performed using χ^2 test with Fisher's exact test. These analyses were performed with the statistical package SPSS version 14.0 (SPSS Japan, Tokyo, Japan). A *P* value less than 0.05 was considered statistically significant.

Results

Table 1 showed characteristic MDCT findings of elderly 38 patients with maxillofacial fractures resulting from falls. This study included 27 patients with condylar fractures, 7 patients with mandibular paramedian fractures, 6 patients with mandibular median fractures, 5 patients with zygomaticomaxillary complex fractures.

The prevalence of male and female were 40.7 % and 59.3 % of condylar fractures (*p* = 0.288), and 80.0 % and 20.0 % of zygomaticomaxillary complex fractures (*p* = 0.170), respectively. Fig.1 and 2 demonstrated the fracture location, degree of fragment dislocation, soft tissue edema and hemorrhage. 3D images to better advantage showed the maxillofacial fractures.

Discussion

Falls were the most common cause of maxillofacial fracture in the elderly patients (5). However, to our knowledge, characteristic MDCT findings of maxillofacial fractures resulting from falls in the elderly have not been reported in the literature. This study was to investigate the characteristic MDCT findings of maxillofacial fractures resulting from falls in the elderly. In this study, MDCT with MPR and 3D images demonstrated to be an effective tool for the detection of fracture location, degree of fragment dislocation, soft tissue edema and hemorrhage. We recommend MDCT, especially for patients who show an extensive craniomaxillofacial trauma, loss of consciousness and depressed vital functions.

In this study, the percentages of male and female were 47.4 % and 52.6 % of maxillofacial fractures resulting from falls in the elderly (over 64 years of age). Goldschmidt et al. (1) showed that males sustained 56.1 % of the craniomaxillofacial fractures in the elderly (60 years of age and older) while females sustained 43.9 %. Fasola et al. (3) showed that the male to female ratio was 1.1 : 1 in patients above 60 years with maxillofacial fractures. However, Ogura et al. (11) showed that the percentages of male and female were 73.2 % and 26.8 % of patients (age 4-87 years, mean age 35.7 years) with mandibular fractures. Sawazaki et al. (15) indicated a male/female ratio of 3.05:1 and a mean age of 28.4 years, for a total of 317 condylar fractures. Yamamoto et al. (16) showed that patients were 163 males and 116 females with an average age of 51.3 years who had fallen on a level surface (simple fall), and 110 males and 68 females with an average age of 31.9 years in falls from a greater height (fall from height),

respectively. The age and gender distributions of maxillofacial fracture patients showed that females were more frequently involved than males in the elderly. We consider that the age and gender distribution is closely related to the circumstance of injury, because life span is the difference between male and female.

Salonen et al. (6, 7) reported that the mandibular condylar fractures were most frequently in falling accidents. Sawazaki et al. (15) reported that median fractures were significantly associated with both unilateral and bilateral fractures of the mandibular condyle. This study indicated that condylar type (71.1 %) was most frequent in maxillofacial fractures resulting from falls in the elderly, followed by paramedian (18.4 %) and median type (15.8 %). We consider that trauma force was applied in the median and paramedian region, causing indirect fractures of the condyle with or without fractures in the median and paramedian region. Furthermore, regarding to elderly patients, the condylar type was considered more frequency in female with maxillofacial fractures resulting from falls. Condylar bone in elderly female may be weak because of bone density, physical status, systemic disease, such as osteoporosis.

Yamamoto et al. (16) showed that, in the midface, the zygomaticomaxillary complex fracture was most frequently involved in falls. Salonen et al. (6, 7) reported that the zygomaticomaxillary complex was the most common fracture of facial trauma in falling accidents. This study indicated that the percentage of zygomaticomaxillary complex type was 83.3 % (5/6 cases) of midface fractures resulting from falls. In this study, the zygomaticomaxillary complex types were considered characteristic MDCT findings of midface fractures resulting from falls in the elderly. Furthermore, the zygomaticomaxillary complex type was considered more frequency in male with maxillofacial fractures resulting from falls. We consider that

trauma force resulting falls was applied in the facial region, causing direct fractures of the zygomaticomaxillary complex types.

Velayutham et al. (5) reported coexisting conditions and polypharmacy in elderly patients with maxillofacial trauma. In the medical conditions, cardiovascular was the most frequent, followed by musculoskeletal included osteoporosis. We consider that the relationship between medical conditions and maxillofacial fractures resulting from fall in the elderly is important for future studies.

The limitations of this study were as follows; the number of elderly patients in the maxillofacial fractures resulting from falls was smaller, and logistic regression was not used to determine the characteristic MDCT findings of maxillofacial fractures resulting from falls in the elderly.

In conclusion, regarding to elderly patients, the condylar type was considered more frequency in female with maxillofacial fractures resulting from falls, and the zygomaticomaxillary complex type was considered more frequency in male with those.

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Figure Legends

Fig. 1 A 67-year-old female with mandibular fractures resulting from falls. Coronal image (a) demonstrates condylar fracture with soft tissue edema (arrow). Coronal image (b) demonstrates that condylar fragment is dislocated mesioanteriorly (arrow). 3D images (c, d) to better advantage show the condylar fracture (arrow).

Fig. 2 A 77-year-old male with midface fractures resulting from falls. Axial image (a) demonstrates zygomatic arch fracture with soft tissue edema (arrow). Axial image (b) demonstrates that zygomatic arch fragment is dislocated (arrow). Axial image (c) demonstrates maxillary fracture with soft tissue edema (arrow) and maxillary sinusitis. Axial image (d) demonstrates that multiple fracture lines of maxillary sinus wall are observed and fragments are dislocated medially (arrow). Coronal image (e) demonstrates maxillary fracture with soft tissue edema (arrow) and maxillary sinusitis. Coronal image (f) demonstrates that multiple fracture lines of maxillary sinus wall are observed and fragments are dislocated medially (arrow). 3D images (g, h) to better advantage show the zygomaticomaxillary complex fractures (arrows).

Fig. 1

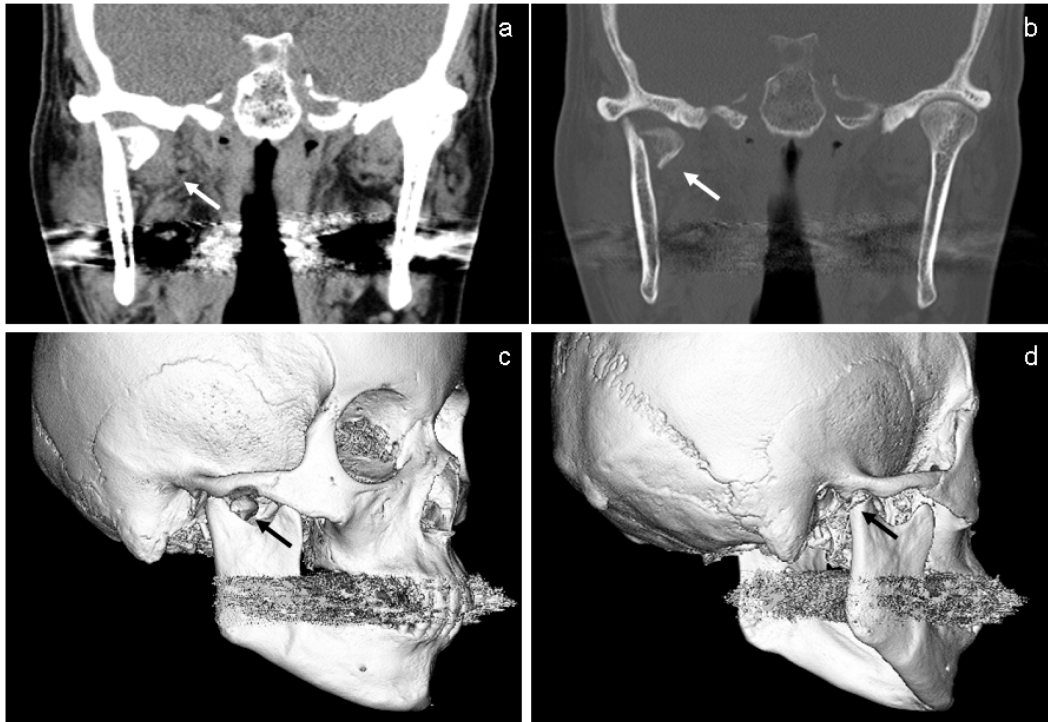


Fig. 2

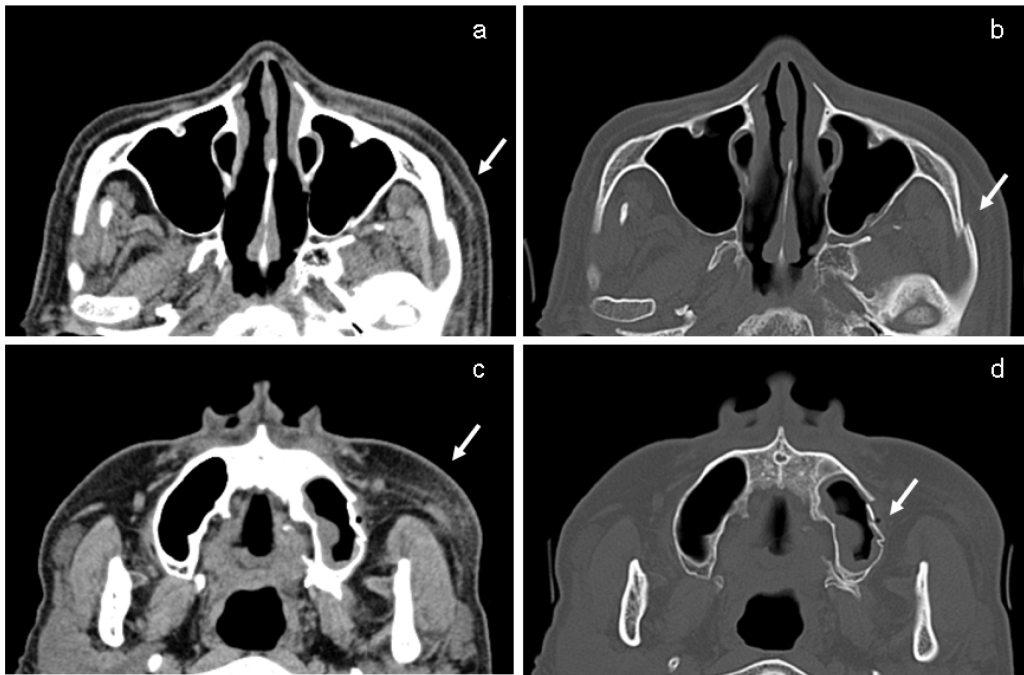


Fig. 2

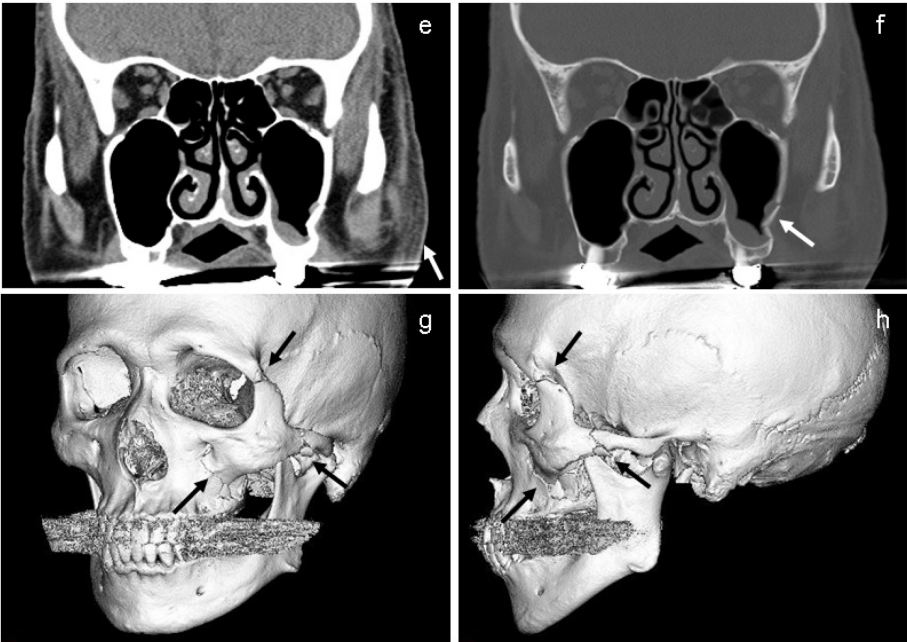


Table 1. Characteristic MDCT findings of elderly patients with maxillofacial fractures resulting from falls

Location of fracture	Male n=18	Female n=20	Total n=38 (100%)	P-value
Mandible				
Median	3	3	6 (15.8%)	1.000
Paramedian	4	3	7 (18.4%)	0.687
Angle	1	0	1 (2.6%)	0.474
Condylar	11	16	27 (71.1%)	0.288
Midface				
Zygomaticomaxillary complex	4	1	5 (13.2%)	0.170
Isolated zygomatic arch	1	0	1 (2.6%)	0.474

MDCT, multidetector computed tomography