

# The Comprehensive AOCMF Classification System: Fracture Case Collection, Diagnostic Imaging Work Up, AOCOIAC Iconography and Coding

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## Abstract

The AO classification system for fractures in the adult craniomaxillofacial (CMF) skeleton is organized in anatomic modules in a 3 precision-level hierarchy with account for an increasing complexity and details. Level-1 is most elementary and identifies no more than the presence of fractures in 4 separate anatomical units: the mandible (code 91), midface (92), skull base (93) and cranial vault (94). Level-2 relates the detailed topographic location of the fractures within defined regions of the mandible, central and lateral midface, internal orbit, endo- and exocranial skull base, and the cranial vault. Level-3 is based on an even more refined topographic assessment and focuses on the morphology – fragmentation, displacement, and bone defects – within specified subregions. An electronic fracture case collection complements the preceding tutorial papers, which explain the features and options of the AOCMF classification system in this issue of the Journal. The electronic case collection demonstrates a range of representative osseous CMF injuries on the basis of diagnostic images, narrative descriptions of the fracture diagnosis and their classification using the icons for illustration and coding of a dedicated software AOCOIAC (AO Comprehensive Injury Automatic Classifier). Ninety four case examples are listed in two tables for a fast overview of the electronic content. Each case can serve as a guide to getting started with the new AOCMF classification system using AOCOIAC software and to employ it in the own clinical practice.

## Keywords

- ▶ craniomaxillofacial fractures
- ▶ classification system
- ▶ case collection
- ▶ clinical documentation system

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Fractures of the craniomaxillofacial skeleton occur in an endless array of different patterns. To design a standardized classification system to categorize fractures in a way that is meaningful, validated and clinically relevant is a challenging long-term project that requires an iterative development process.

A key prerequisite in the development of a classification system is to establish a reproducible visual language and coding to ensure referral to identical fracture entities across medical disciplines.<sup>1</sup>

The new AO classification system for fractures of the craniomaxillofacial (CMF) skeleton in adults is organized in several anatomic modules in a precision-level hierarchy relating to the rendition of topographical details and fracture morphology.

The introduction of precision levels offers versatility and staged procedures during the developmental phase, the validation process and the finalization of a classification proposal.

Three precision levels enable to refine the documentation of fractures according to their complexity:

- Level-1 is most elementary and identifies no more than the presence of fractures in 4 separate anatomical units: the mandible (code 91), midface (92), skull base (93) and cranial vault (94).

- Level-2 relates the detailed topographic location of the fractures within defined regions of the mandible, central and lateral midface, and internal orbit. The endocranial surface of the skull base is divided in 9 regions: a central part further subdivided into 3 components (cribriform plate and ethmoido-sphenoidal planum, sellar/parasellar compartment, clivus) adjoined by two lateral parts each encompassing an anterior, middle and posterior component. The regions of the exocranial skull base and the cranial vault are defined according to common anatomical nomenclature into paired and non-paired bones: frontal, parietal, temporal, sphenoid and occipital.
- Level-3 is based on an even more refined topographic assessment and focuses on the morphology – fragmentation, displacement, and bone defects – within the specified subregions, parts and components.

### Objective

The purpose of this paper is to present an electronic case collection complementing the series of tutorial papers<sup>2-8</sup> about the AOCMF classification system preceding in this issue of the Journal. The electronic cases demonstrate a range of representative osseous CMF injuries on the basis of diagnostic images, narrative descriptions of the fracture diagnosis and their classification using the icons for illustration and coding

**Table 1** Case examples of mandibular fractures

AOCMIAC ID	Description	Collection ID
<b>Level 2 case examples<sup>2</sup></b>		
CMTR-91-003	Body fracture traversing anterior transition zone	1
CMTR-91-004	Body region fracture	2
CMTR-91-005	Angle fracture in posterior transition zone	3
CMTR-91-007	Fracture fully within posterior transition zone	4
CMTR-91-008	Horizontal angle / ramus fracture	5
CMTR-91-010	Vertical angle / ramus fracture	6
CMTR-91-011	Isolated coronoid fracture	7
CMTR-91-012	Condylar process fracture	8
CMTR-91-014	Double fracture of the mandible (a)	9
CMTR-91-016	Double fracture of the mandible (b)	10
CMTR-91-017	Multifragmented fracture within right ascending ramus with condylar 2 process involvement	11
CMTR-91-018	Triple mandibular fracture (a)	12
CMTR-91-019	Triple mandibular fracture (b)	13
CMTR-91-020	Triple mandibular fracture (c)	14
CMTR-91-021	Multiple mandible fractures	15
CMTR-91-022	Mandibular fracture within the posterior transitional zone	16
CMTR-91-023	Condylar process fracture on edentulous mandible	17
CMTR-91-025	Mandibular body fracture	18
CMTR-91-002	Anterior transition zone determination in edentulous mandible	19 - Tutorial

**Table 1** (Continued)

AOCOIAAC ID	Description	Collection ID
CMTR-91-013	Nonconfined fracture over symphysis and body	20 - Tutorial
CMTR-91-015	Double fracture of the mandible (c)	21 - Tutorial
<b>Level 3 case examples (excl. condylar process)<sup>3</sup></b>		
CMTR-91-051	Alveolar process fracture	22
CMTR-91-052	Alveolar process fracture region 42–45	23
CMTR-91-053	Double fracture with basal wedge fracture within anterior transition 1 zone (on the right) and angle fracture on the left	24
CMTR-91-054	Multifragmented mandibular body region	25
CMTR-91-055	Major fragmentation confined to the symphyseal region	26
CMTR-91-056	Major fragmentation extending between the lateral symphysis and the 1 anterior body region	27
CMTR-91-057	Body fracture with major fragmentation	28
CMTR-91-024	Major fragmented fracture body and symphysis	29
CMTR-91-058	Multiple fractures of an edentulous mandible	30
CMTR-91-059	Bilateral body fracture in a severely atrophic mandible	31
CMTR-91-060	Fragmented angle-ramus fracture	32
CMTR-91-061	Long reaching sagittal fracture from angle/ramus to symphysis plus 1 bilateral condylar head fractures	33
CMTR-91-001	Symphysis fracture of grade 0 fragmentation	34 - Tutorial
CMTR-91-026	Two fracture lines in conjunction with alveolar process fracture	35 - Tutorial
CMTR-91-027	Body fracture of grade 2 fragmentation extending into the symphysis	36 - Tutorial
<b>Level 3 Condylar Process<sup>4</sup></b>		
CMTR-91-102	Unilateral condylar base fracture with lateral override/ramus 3 shortening	37
CMTR-91-104	Bilateral condylar process neck and head fractures	38
CMTR-91-106	Borderline condylar head fracture	39
CMTR-91-107	Atypical condylar head and neck fracture	40
CMTR-91-108	Non-fragmented neck fracture	41
CMTR-91-109	Neck fracture and sagittal symphysis-to-angle/ramus fracture in 1 edentulous mandible	42
CMTR-91-101	Unilateral condylar base fractures with lateral override	43 - Tutorial
CMTR-91-103	Condylar neck fracture	44 - Tutorial
CMTR-91-105	Bilateral condylar head fractures	45 - Tutorial

Abbreviations: AOCOIAAC, AO Comprehensive Injury Automatic Classifier<sup>9</sup>; Tutorial, case presented in the respective tutorial article.

of a dedicated software AOCOIAAC (AO Comprehensive Injury Automatic Classifier).<sup>9</sup>

The electronic case collection is intended to serve as a guide in getting started and familiar with all the nuances of the AOCMF classification system. A total of 94 case examples listed in two tables (– **Tables 1** and **2**) provides a fast overview to select appropriate fracture patterns for a first orientation or comparison in reference to injuries in the own clinical setting. The case examples are grouped according to the sequence of the preceding tutorial papers, which accounts for the anatomical regions/ subregions and the 3 precision levels. The tables list the documentation ID used for documentation within the integrated database in AOCOIAAC and indicate case examples simultaneously published in the tutorial papers.

## Access to Additional Electronic Content

Each fracture case example is available electronically from a Website of AOCMF ([www.aocmf.org/classification](http://www.aocmf.org/classification)) for viewing and editing by use of the new CMF fracture module of AOCOIAAC software.<sup>9</sup> A freeware copy of AOCOIAAC (Version 4.0) and its user manuals can be obtained at the following Website: [www.aofoundation.org/aocoiac](http://www.aofoundation.org/aocoiac).

### Note and Disclaimer

While the developers thrived to make AOCOIAAC 4.0 software as user-friendly and applicable as possible, they cannot guarantee it is problem-free and will work adequately on all computers. The user manuals should be read carefully

**Table 2** Case examples of midface, cranio-facial skull base and cranial vault fractures

AOCOIAC ID	Description	Collection ID
<b>Level 2 Midface<sup>5</sup></b>		
CMTR-92-004	Zygoma fracture	46
CMTR-92-005	Zygoma and nose fractures with ICM involvement	47
CMTR-92-006	Isolated fracture of the zygomatic arch	48
CMTR-92-007	Fracture on the zygomatic arch	49
CMTR-92-008	Fracture of the anterior maxillary sinus wall (ICM)	50
CMTR-92-009	Le Fort I fracture (LCM) and nasal bone involvement	51
CMTR-92-010	Naso-orbito-ethmoid (NOE) fracture	52
CMTR-92-011	Complex fracture pattern of the central and lateral midface	53
CMTR-92-012	Le Fort I fracture pattern with bilateral zygoma fractures	54
CMTR-92-013	Displaced zygoma fracture	55
CMTR-92-001	Fracture of the upper central midface	56 - Tutorial
CMTR-92-002	Bilateral Le Fort I fracture associated with nasal bones and zygoma fracture on the left side	57 - Tutorial
CMTR-92-003	Zygoma fracture on the left side	58 - Tutorial
<b>Level 3 Midface<sup>6</sup></b>		
CMTR-92-107	Undisplaced midface fracture: bilateral Le Fort I, unilateral Le II Fort 7 II right, and zygoma left - as component of a panfacial fracture	59
CMTR-92-108	Zygoma minimally displaced with multifragmentation of ZMC and ZSS	60
CMTR-92-109	Le Fort I Type 1, 2 and 3 fracture combination, bilateral NOE and frontal sinus fractures	61
CMTR-92-110	Panfacial fracture - retrodisplaced Le Fort I, II, III midface fracture, parasagittal palatal fracture and triple mandibular fracture: symphyseal fracture and bilateral condylar base fracture	62
CMTR-92-111	Complex zygomatic fracture	63
CMTR-92-112	Pancraniofacial fracture	64
CMTR-92-113	Central craniofacial - asymmetric bilateral NOE fracture in combination with frontal sinus fracture	65
CMTR-92-114	Midface fracture: atypical Le Fort I and II combined with palate, atypical zygoma left and involvement of greater sphenoid wing left	66
CMTR-92-101	Asymmetric Le Fort Level midface fracture	67 - Tutorial
CMTR-92-102	Zygoma Fracture left with dorsocranial displacement and antral impaction	68 - Tutorial
CMTR-92-103	Panfacial fracture including lower central midface fracture analogous to Hemi Le Fort I fracture	69 - Tutorial
CMTR-92-104	Naso-orbito-ethmoidal fracture bilateral (Example 1)	70 - Tutorial
CMTR-92-105	Naso-orbito-ethmoidal fracture (Example 2)	71 - Tutorial
CMTR-92-106	Lateral cranio-orbito-facial injury: fronto-spheno-zygomatiko-orbital fracture	72 - Tutorial
<b>Level 3 Orbit<sup>7</sup></b>		
CMTR-92-204	Orbital floor fracture	73
CMTR-92-205	NOE fracture	74
CMTR-92-206	Orbital floor fracture	75
CMTR-92-207	Zygoma fracture on the right side with inferior rim involvement	76
CMTR-92-208	Zygoma fracture on the left side with inferior rim involvement	77
CMTR-92-209	Four wall orbital fracture with complete bilateral disintegration	78
CMTR-92-210	Fracture of the medial orbital wall in the anterior and middle section	79
CMTR-92-211	NOE fracture on the right side with displacement	80

**Table 2** (Continued)

AOCOIAC ID	Description	Collection ID
CMTR-92-212	Isolated medial orbital wall fracture	81
CMTR-92-213	Bilateral fractures of the orbital roof	82
CMTR-92-201	Orbital floor fracture with intraorbital buttress involvement	83 - Tutorial
CMTR-92-202	Isolated medial orbital wall fracture with apex involvement	84 - Tutorial
CMTR-92-203	Zygoma fracture on the right side	85 - Tutorial
<b>Level 2 and 3 Skull Base and Cranial Vault<sup>8</sup></b>		
CMTR-93-94-004	Frontal cranial vault with right and central skull base fractures	86
CMTR-93-94-005	Linear fracture involving the cranial vault and middle fossa skull base	87
CMTR-93-94-006	Multiple, depressed and multifragmentary frontal cranial vault fractures with anterior skull base involvement	88
CMTR-93-94-007	Anterior skull base fracture	89
CMTR-93-94-008	Bilateral cranial vault fractures with extension into the anterior and middle skull base	90
CMTR-93-94-009	Parietal cranial vault fracture with depression into the brain	91
CMTR-93-94-001	Multiple cranial vault fractures	92 - Tutorial
CMTR-93-94-002	Single skull base fracture extending into the temporal cranial vault	93 - Tutorial
CMTR-93-94-003	Right occipital and temporal cranial vault fracture extending into the right middle fossa skull base	94 - Tutorial

Abbreviations: AOCOIAC, AO Comprehensive Injury Automatic Classifier<sup>9</sup>; Tutorial, case presented in the respective tutorial paper.

before installation and use. The AO Foundation cannot take responsibility for any damages or inconveniences that may occur by using the available most current software version. For use of the AOCOIAC software, its manuals and all case examples, the AO Foundation terms, conditions, and disclaimers apply (<https://www.aofoundation.org/Structure/the-ao-foundation/Pages/legal.aspx>).

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