

The First AO Classification System for Fractures of the Craniomaxillofacial Skeleton: Rationale, Methodological Background, Developmental Process, and Objectives

Laurent Audigé, DVM, PhD^{1,2} Carl-Peter Cornelius, MD, DDS³ Antonio Di Ieva, MD, PhD⁴
Joachim Prein, MD, DDS⁵ CMF Classification Group⁶

¹ AO Clinical Investigation and Documentation, AO Foundation, Dübendorf, Switzerland

² Research and Development Department, Schulthess Clinic, Zürich, Switzerland

³ Department of Oral and Maxillofacial Surgery, Ludwig Maximilians Universität München, Germany

⁴ Department of Systematic Anatomy and Department of Neurosurgery, Medical University of Vienna, Wien, Austria

⁵ Clinic for Oral and Craniomaxillofacial Surgery, University Hospital Basel, Basel, Switzerland

⁶ CMF Classification Group

Address for correspondence Laurent Audigé, DVM, PhD, AO Foundation, AO Clinical Investigation and Documentation, Stettbachstrasse 6, CH-8600 Dübendorf, Switzerland (e-mail: laurent.audige@aofoundation.org).

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Abstract

Validated trauma classification systems are the sole means to provide the basis for reliable documentation and evaluation of patient care, which will open the gateway to evidence-based procedures and healthcare in the coming years. With the support of AO Investigation and Documentation, a classification group was established to develop and evaluate a comprehensive classification system for craniomaxillofacial (CMF) fractures. Blueprints for fracture classification in the major constituents of the human skull were drafted and then evaluated by a multispecialty group of experienced CMF surgeons and a radiologist in a structured process during iterative agreement sessions. At each session, surgeons independently classified the radiological imaging of up to 150 consecutive cases with CMF fractures. During subsequent review meetings, all discrepancies in the classification outcome were critically appraised for clarification and improvement until consensus was reached. The resulting CMF classification system is structured in a hierarchical fashion with three levels of increasing complexity. The most elementary level 1 simply distinguishes four fracture locations within the skull: mandible (code 91), midface (code 92), skull base (code 93), and cranial vault (code 94). Levels 2 and 3 focus on further defining the fracture locations and for fracture morphology, achieving an almost individual mapping of the fracture pattern. This introductory article describes the rationale for the comprehensive AO CMF classification system, discusses the methodological framework, and provides insight into the experiences and interactions during the evaluation process within the core groups. The details of this system in terms of anatomy and levels are presented in a series of focused tutorials illustrated with case examples in this special issue of the Journal.

Keywords

- fracture
- classification system
- craniomaxillofacial
- diagnostic process
- reliability

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AOCMF
Clavadelstrasse 8
7270 Davos
Switzerland
Tel: +41 44 200 24 20.

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Cranial vault, skull base, and face fractures have often been described separately, even though they may be combined. These fractures in the different locations are assigned to different specialist competencies, which leads to the need for several distinct specialists to discuss their views among each other, for example, traumatologists, oral and maxillofacial surgeons, plastic surgeons, ENT surgeons, neurosurgeons, ophthalmologists. These professionals have specific expertise regarding craniomaxillofacial (CMF) injuries, yet these competencies can vary across countries and their educational systems. The lack of borderlines between the specialties may also be due to the lack of clear guidelines or the lack of a universally validated classification system. Classification systems are important because they offer a structured framework to communicate effectively about clinical cases, and support the treatment decision process (i.e., conservative vs. surgical management, type of surgical intervention, type of specialist required). An integral modular classification system validated by all involved medical disciplines might be an essential cornerstone to improve synergies and mutual acceptance.

In biomedical sciences, classification systems are omnipresent. Almost every advent of a new technology or novel diagnostic/therapeutic regimen is publicized together with the urge to reconsider former systematization and conceptions. This is reflected in headlines and titles containing vocabulary such as grouping, coding, rating, grading, scaling, scoring, and typifying, which is indicative for a classifying process. A classification scheme is the “descriptive information for an arrangement or division of objects into groups based on characteristics which the objects have in common.”¹ Medical classification is “the process of transforming descriptions of medical diagnoses and procedures into universal medical code numbers.”² Known examples of such diagnoses and procedure codes are the WHO Family of International Classifications³ including the International Classification of Diseases, the Medical Dictionary for Regulatory Activities, and the Medical Subject Headings.

In the making of a classification scheme, a key issue is to determine the most relevant “common characteristics” mentioned above. The extreme heterogeneity of human skeletal fractures makes it difficult to identify appropriate parameters and standardization for assigning a clinical series of unique cases into a fixed number of possible classes using a structured mode.

A Multitude of Existing CMF Classification Systems

Over more than a century, a multitude of classifications were created to detail site-specific fracture entities of the craniofacial skeleton (► **Table 1**). Till date, midface fractures are referred to worldwide by the name of Le Fort.⁴ His experimental cadaver studies led to an understanding of the honeycomb construction of the midfacial skeleton and of the major lines of weakness. The relation between bony architecture and the predictable course of the fractures served to describe a limited number of well-defined patterns.^{5–7} The

Table 1 References of most common fracture classifications of the craniomaxillofacial skeleton

Location	References
Midface	Guérin, ⁵⁶ Le Fort, ^{5–7} Wassmund, ⁵⁷ Donat et al ¹⁶
Zygoma	Zingg et al ⁵⁸
Orbitozygomatic and orbitoethmoid region	Jackson ⁵⁹
Nasoethmoid region	Markowitz et al ⁶⁰
Orbit	Hammer, ⁶¹ Carinici, ⁶² Jacquiéry et al ⁶³
Medial orbital wall	Nolasco and Mathog ⁶⁴
Palate	Chen et al, ⁶⁵ Park and Ock ⁶⁶
Midface in conjunction with skull base	Buitrago-Téllez et al, ⁸ Bächli et al, ²⁶ Manson et al ⁶⁷
Frontal base	Madhusudan et al ⁶⁸
Temporal bone	Rafferty et al ⁶⁹
Mandible	Spiessl, ⁷⁰ Roth et al, ⁷¹ Buitrago-Téllez et al, ²¹ Carinci et al ⁷²
Condylar process of the mandible	Spiessl and Schroll, ⁷³ Loukota et al ^{74,75}
Panfacial injuries and avulsions	Clark et al ⁷⁶

simple distinction of three Le Fort type fractures is considered as a prototype of a classification system for midface fractures. Notably, Buitrago-Téllez et al⁸ found that only 45% of midface fractures could be adequately classified according to the Le Fort classification in practice. The Le Fort classification has often been criticized as obsolete by later authors, since it is confined to the subcranial facial skeleton and does not display the full variety of possible fracture types in all details. To his credit, Rene Le Fort did not have conventional radiography at his disposal and would not have even dreamed of computed tomography (CT), magnetic resonance imaging, or the use of optoelectronic navigational tools in the management of skull fractures.

Rationale for a New Comprehensive CMF Classification

Despite the existence of many classification systems (► **Table 1**), a comprehensive and structured classification of the whole CMF skeleton that has undergone a structured validation process has not been proposed until now. A clinically relevant, well-structured, and agreed-upon classification provides a universal language and coding that facilitates global communication and collaboration. The conduction and comparison of clinical studies is not possible without clear descriptors of the trauma patients and their injuries. Coding and indexing is a prerequisite to use present-day information and computing media for web-based

exchange and storage of records on fractures in trauma databases. A structured classification system enables large-scale documentation (e.g., registries), interinstitutional comparisons, quality control, and performance evaluation of treatment modalities,⁹ and the adoption of benchmarking methods to possibly optimize the surgical procedures and economic analysis. After all, CMF surgeons could soon be required by health authorities to document patient care and treatment performance to justify the increasing costs of healthcare.¹⁰

In clinical settings, injury classification systems ideally help surgeons in making their decision on the most appropriate treatment modality; classification categories reflect injury severity and include prognostic factors for clinically relevant patient outcomes.¹¹ A comprehensive CMF fracture classification will provide a sound basis to evaluate treatment modalities and outcomes thoroughly and help to integrate the results into the daily routines of decision making for evidence-based CMF management.^{12–15} Based on scientific data, CMF surgeons will be in a stronger position to advise their patients on the best course of action to treat their respective conditions.

Expected Attributes of a Valuable CMF Classification

Reflecting on a few essential diagnostic and classification issues allows one to identify the most important attributes which are necessary to achieve the objective of the classification.

As pointed out by Donat et al,¹⁶ a classification system for midfacial/craniofacial fractures should be “logically structured, systematic, accurate, comprehensive, it should provide information regarding the severity of the injury and a guidance to the therapeutical options.”

Comprehensiveness

Fractures of the human skeleton are particularly varied, thus rendering it a major challenge to identify appropriate parameters and standardization to assign a clinical series of unique cases into a fixed number of possible classes in a structured and clinically useful process. While many classification systems have been proposed (►Table 1), the link between mandible, midfacial, cranial vault, and skull base fractures is often missing. A comprehensive classification would address the whole CMF skeleton in a uniform scheme. In addition, the classification should be all inclusive, that is, all CMF injuries should be classifiable using the proposed system as well as mutually exclusive (such that these injuries cannot be classified in more than one classification category in the system).

Clinically Relevant Diagnosis and Treatment Decision

Initially, it may seem reasonable to include all conceivable factors and patient details into the classification. However, this would become unmanageable in routine clinical use. These pertinent factors all contribute to the daily treatment decisions made by surgeons (►Fig. 1). Although, the observed

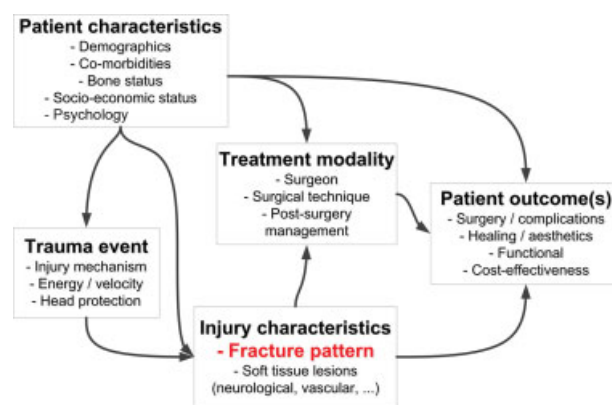


Figure 1 Multiple patient and injury factors influencing treatment decision and outcomes. Note: The fracture pattern described by location and morphology is only one of the many factors influencing treatment decision and outcomes.

fracture pattern is only one of these factors, it is still the most relevant clinical feature for establishing a diagnosis and thus supporting a treatment decision.

In the development of a classification system, it is therefore of utmost importance to identify the most relevant items that will support the treatment decision.^{17,18} The resulting categories might be indicative of some specific injury characteristics such as severity, that is, they can reliably distinguish groups of injuries that differ regarding the complexity of their treatment, or the quality of their outcome(s).¹⁸ Most importantly, a fracture classification system should be based on their essential biological characteristics, that is, fracture topography and morphology,¹⁹ and not explicitly include treatment-based criteria to ensure universality of the system.

User Friendliness and Discernibility

A fracture classification system should be simple to use and therefore limited to a few pertinent parameters. must not allow for complete individualized fracture mapping. The necessary process of abstraction in the development of the system is always a tradeoff between detailed individualized information and the use of restricted categories associated with loss of information.

Reliability/Accuracy

In addition to clinical relevance, a good fracture classification should provide a reliable and accurate means of communication. Different observers presented with the same diagnostic images (e.g., CT scan series) must agree on the classification of a fracture most of the time (reliability of the diagnosis). The classification should also reflect the true injury status of the patient (accuracy of the diagnosis), that is, observers should accurately identify the most clinically relevant fracture patterns. If this is not the case, the classification has failed in its fundamental goal—a means to communicate information based on agreed similarities and differences.

In traumatology, most published reliability studies generally showed poor interobserver reliability of commonly used classifications.²⁰ In the CMF field in particular, reliability studies were rarely conducted. Recently, Buitrago-Tellez

et al²¹ reported on one of our initial evaluation sessions regarding a proposed classification system for mandibular fractures. In orthopedics, it has become a standard that injury classification systems be formally validated before their approval for clinical and research purposes.^{20,22–24}

Fracture Classification versus Injury Severity Score

The use of an injury severity score implies that the magnitude of the injuries can be graded on a continuous or ordinal scale and that this score has some predictive value for treatment options and/or outcome(s). Various attempts were made to build up fracture severity scores for the CMF region^{21,25–30} based on several diagnostic parameters. The final severity scores are calculated by adding points allocated to each of these diagnostic parameters and anatomical region found to be relevant in guiding treatment decisions. The actual point systems, however, were elicited by the authors or expert opinion without solid scientific basis, leading to some uncertainty pertaining to the validity of the actual numeric final score. For instance, Catapano et al³¹ proposed a new severity scoring of facial fractures which sums a grade of 0 (no fracture) to 3 (bone loss) across 41 anatomical regions. Because all regions received equal weighting, an increased severity of some fracture patterns may not be systematically associated with an increased score. Also, the final score may not be handled on a continuous scale. The weighting of diagnostic categories and regions to generate severity scores should have a sound scientific basis, that is, the score calculation algorithm requires clinical data to create prognostic models. This process has been applied in the context of outcome analysis systems to provide norms for trauma care.^{32–34}

A typical limitation of severity scores is that the score itself cannot be reversed into the fracture pattern and, stand-alone, only provides prognostic information. For that reason, after having considered the potential value of a CMF injury severity score at the initial development stages,²¹ the objective of this project was strictly focused on the development of a clinically meaningful classification system allowing intelligible picturing of the fracture patterns. This system may be subsequently translated into a severity score following appropriate clinical documentation.

AOCMF Classification Group—A Brief History

An international Craniomaxillofacial Classification Group (CMCG) including an extended company of multispecialty surgeons experienced in the management of CMF fractures was established in 2004 with the task of developing a clinically relevant and valid CMF comprehensive fracture classification system. Scientific coordination and organizational support to the group were provided by AO Clinical Investigation and Documentation. The list of participating surgeons involved in the initial classification activities is presented in the Acknowledgment section. This group initially followed on the craniofacial fracture work of Buitrago-

Tellez et al,⁸ and adapted the same approach to the mandible.²¹ However, after several evaluation sessions, consensus could not be achieved among evaluating surgeons. An alternative classification concept was required. As a consequence, a critical step toward the development of the present system was done. The CMCG was reorganized in 2007 with a smaller core membership of five experienced CMF surgeons (J.P., C.P.C., C.K., J.F., R.R.), one radiologist (C.B.), and a scientific coordinator (L.A.). In addition, two specifically focused Classification Groups (CGs) were established to develop part of the system addressing skull base fractures (C.M., A.D., K.S., B.K.) and condylar process fractures (M.R., A.N., C.P.C.).

Broad international acknowledgment and changeover as standard application of the comprehensive CMF system in clinical institutions worldwide was a key objective of this project. The involvement of experienced surgeons from various geographical and clinical backgrounds (e.g., CMF surgeons, ENT surgeons, plastic surgeons, neurosurgeons) in classification groups facilitates identification of cross-cultural differences in training and understanding of basic clinical concepts and definitions.

Classification Development and Validation Pathway

According to the AOCMF and its CMF classification groups, a list of expected properties for the classification system was drawn up (►Table 2).

Table 2 Targeted properties of the CMF classification system

1	Address only traumatic CMF fractures
2	Be comprehensive, including the whole CMF skeleton
3	Be applicable to the mature skeleton ^a
4	Consider a hierarchical system from very simple for all surgeons to more detailed and focused for specific locations and specialist surgeons
5	Describe fracture location and morphology based essentially on CT scans (or for mandibular fractures, Panorex and/or conventional radiographs in two planes)
6	Be consistent with well-accepted systems such as the Le Fort classification in the midfacial skeleton ^{5–7}
7	Be perceived by CMF surgeons as simple, practical, and clinically meaningful
8	Demonstrate a reasonable level of reliability and accuracy for most common fractures
9	Provide a rational basis for prospective (functional and patient reported) treatment outcome studies, from which algorithms for clinical decision making can be derived
10	Reach international acceptance
11	Be incorporated into an electronic database, such as a specialized software solution to facilitate teaching, classification, and documentation of CMF cases

Abbreviation: CMF, craniomaxillofacial.

^aMaxillofacial trauma in pediatric patients requires different considerations from those of adults, with different therapeutic approaches.⁷⁷

In the development and validation of classification systems, Audigé et al.³⁵ suggested implementing a methodological pathway with three successive research phases (►Fig. 2). The first phase involves clinical experts developing a blueprint for the classification system, as well as defining the assessment technique (e.g., clinical information, image modalities, measurement aids). Precise definitions and instructions need to be worked out to define a common language by which surgeons should be able to understand, identify, and describe injuries in a uniform way. Successive pilot agreement studies are conducted to evaluate the reproducibility of the classification performed by clinical experts. The natural tendency of all CGs was to initiate the development by proposing a very detailed system to address all injury patterns. Participants realized after a few evaluation sessions that simplification is only warranted, along with the clarification of definitions for terms that are commonly used (e.g., “fragmentation” or “comminution”). This process is not easy and involves translating clinical experience (pattern recognition) into a set of standardized definitions. At this stage, the predictive clinical value of any proposed system is evaluated by expert opinion (concept of face validity, that is, the classification should look good on clinical ground). The second phase involves a multicenter agreement study to ensure that future users with less clinical experience can understand and agree on the classification system. This creates the basis for a classification tool to be used for documentation and evaluation of treatment options. Only after these first two phases have been completed can a third phase involving prospective clinical documentation be implemented to support future recommendations for patient care based on the classification.

This methodological pathway has been adopted and implemented successfully within all classification projects supported by the AO Foundation and its specialties, in particular for the development of the established AO pediatric long-bone fracture classification system,^{36,37} and the development of a comprehensive AO-Spine injury classification.³⁸

The currently proposed CMF fracture classification is the product after completion of phase 1. More specifically, it involved for each CG a series of face-to-face meetings to gradually build up the classification system itself as well as the prerequisites (e.g., imaging type and quality) under which it can be reliably used. In the period between the meetings,

surgeons evaluated the proposed or revised system by conducting classification sessions using imaging series (conventional radiographs and CT scans) of up to 150 consecutive cases. Overall, the image documentation of 494 consecutive CMF fracture cases collected from 6 European centers was anonymized and centralized at AOCID for use in successive evaluation sessions. Cases were sent to surgeons on digital video disks together with a DICOM viewer. They classified the cases independently each time according to the most updated version. Classification data were collected either on paper forms or electronically using MS Excel (Microsoft Corporation, Redmont, WA) or specifically designed AOCOIA software (AO Comprehensive Injury Automatic Classifier, AO Foundation, Dübendorf, Switzerland; www.aofoundation.org/aocoia). The datasets were analyzed for classification reliability and accuracy as well as for identification of cases showing most coding discrepancies between surgeons. These latter cases were discussed during the subsequent face-to-face meetings to identify the probable reasons for the inter-observer disparities in order for adjustments and clarification of the actual version. Group members also had to agree that the proposed system would meet initial expectations (►Table 2); further evaluation is to come and should involve a wider circle of CMF surgeons (phase 2 validation process) to support the current consensus, and allow final adaptations of the system.

Consensus, Challenges, Strength, and Limitations

The development of this comprehensive CMF fracture classification used a strong consensus process among experienced surgeons aimed at measuring and resolving disagreement (consensus development). There are many traditional methods used to reach group consensus.^{39–43} In the medical field, the application of group consensus has mainly been used in the development of standards and guidelines for diagnosis and treatment,^{44,45} and has provided relatively consistent and reliable results.^{46–48} Our consensus approach toward classification development incorporated an immediate practical application through classification evaluation sessions. These sessions allowed surgeons to gain experience using the proposed system, and after considering the classification discrepancies, review meetings could be focused on the essential issues to improve the system.

Experienced surgeons are busy professionals and the repetition of classification sessions on a series of 50 to 150 cases required a high level of dedication and investing personal time from the participants. It was a great challenge to maintain the CGs motivation and commitment throughout the consensus process. A phase 1 development project often requires 3 to 4 years to reach a solid and scientifically supported consensus.^{36,49}

Some limitations should be mentioned. Initially, surgeons classified cases during meetings; however, the process was changed to reserve meetings for case discussion based on coding disagreements. Classification sessions were then conducted at home. There was always a tradeoff between

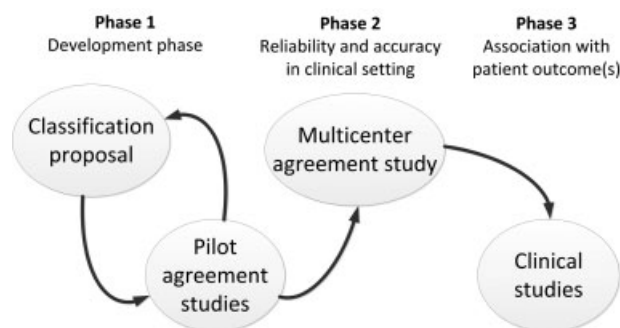


Figure 2 Methodological pathway for the development and validation of injury classification systems. Reprinted with permission from Audigé et al.³⁵

methodological concerns and practical issues. The number of consecutive cases that can be classified in any session is limited by the surgeon's time and thus only the most frequent fracture patterns were examined. To address rare fractures, subsequent follow-up evaluation projects should be implemented.

The present classification system and evaluation sessions were limited by the type and quality of the images made available. Cases with images considered insufficient for classification purposes were excluded from the series. It should be noted that some part of the CMF classification system will require more advanced imaging for a thorough evaluation process, such as craniomaxillofacial fractures documented by multidetector CT.⁵⁰ We must also accept that imperfections in the system will be detected by further technological advances resulting in improved (computer-assisted) diagnosis processes and classification, by means of new algorithms and imaging sequences such as those using high-resolution multiplanar reformations.⁵¹

The Present AOCMF Fracture Classification System—History Outline and Structure

From Maurice Müller to International Collaboration

In 1986, the AO Foundation officially adopted "The Comprehensive Classification of Fractures of the Long Bones" developed by Maurice Müller and his group as a groundwork for its activities in documentation. This system introduced a standardized alphanumeric code to indicate the affected bone and fracture morphology within the specific bone location, according to three types (A, B, and C), three groups within each type (A1, A2, and A3), and three subgroups within each group (A1.1, A1.2, and A1.3) ranging from low (A1.1) to high (C3.3) "severity." The latter relates to the complexities of the fractures, the assumed difficulties inherent in their treatment, and their perceived prognosis.⁵² This classification concept became a standard worldwide for long bone fractures and was later adopted for fractures of the pelvis/acetabulum,⁵³ the hand⁵⁴ as well as spine injuries.⁵⁵

On the same path, the AO Foundation has made persistent efforts to create a classification of craniofacial injuries. The project was launched by the work of Buitrago-Téllez et al,⁸ who initially designed a CT-based diagnostic algorithm for craniomaxillofacial fractures to establish a hierarchical classification of increasing severity. The elementary concept was to split craniofacial fracture patterns analogous to the AO triad system. The craniofacial region was divided into three units: the lower midface (I), the upper midface (II), and the cranio-basal-facial unit (III). Lateral and central fractures were also distinguished. This allowed a standardization of the midfacial and craniofacial fractures in a special way described with regard to their severity. With the subsequent establishment of a first CMF classification expert panel, a classification system for the mandible differentiating vertical mandibular compartments and a horizontal subdivision of the body and parasymphiseal region was proposed on the same principles.²¹ At the same time, the AO Classification Advisory group and the OTA Classification Committee agreed on a uniform

numerical coding of the bones and anatomical regions of the human skeleton, with fractures of the CMF skeleton being coded with the number 9 (►Fig. 3).¹⁸ The presented AO CMF classification system is anchored within a global and uniform system to support surgeons documenting their fractures similarly.

New Hierarchical Classification System

The first classification evaluation sessions and review meetings led to the realization that the initial system was not intuitive enough to achieve consensus among surgeons involved in the evaluation process. An agreement concerning the definitions using the AO triad system^{8,21} could not be achieved in the evaluation meetings to continue the implementation of this system. One of the reasons may be hypothetically due to the adoption of the AO-Müller triad scheme, well accepted for long bones,¹⁷ but not very familiar among CMF specialties.

So the triad system was not considered mandatory for the CMF skeleton anymore. A paradigm shift was required toward the development of a streamlined classification system considered as practical, clinically meaningful, and still scientifically sound. Despite the present system being built on all previous endeavors and published classification work (►Table 1), it had to be accepted a priori that the system was not meant to map each and every conceivable combina-

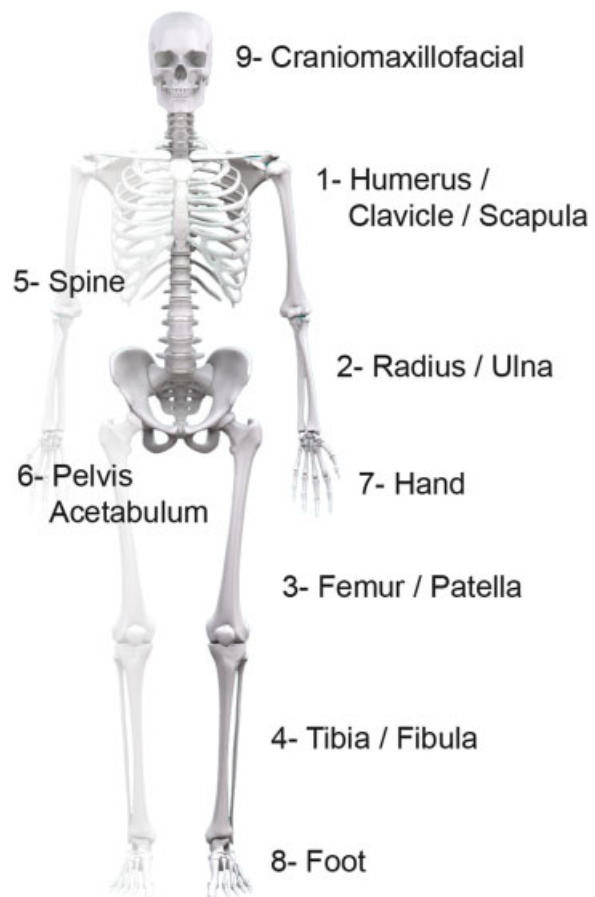


Figure 3 Unified classification system for fractures of the human skeleton. Adapted from Marsh et al.¹⁸

tion of every single fracture line in a CMF injury, and restriction to the most relevant diagnostic items for clinical practice was essential.

The present AOCMF fracture classification system is based on a hierarchical structure of three levels from very simple to more focused and complex:

- Level 1: elementary system for gross fracture location: mandible (code 91), midface (code 92), skull base (code 93), cranial vault (code 94)
- Level 2: basic system for refined fracture location in the CMF skeleton (outlining the topographic boundaries of the anatomical regions within the fundamental units of the CMF skeleton as a basis for a more precise localization)
- Level 3: focused modular system assessing fracture morphology (i.e., fracture lines, level of fragmentation, and displacement)

While levels 1 and 2 serve as approved anatomical localizers, level 3 describes the fracture morphology in an array of modules representing anatomical regions and subregions.

A detailed presentation of each classification level and module is presented in the following series of tutorial papers in this special issue of the Journal along with typical and difficult case examples according to specific anatomical locations:

- Level 2 craniomidface
- Level 2 mandible
- Level 3 mandible (excluding the condylar process)
- Level 3 condylar process
- Level 3 midface (excluding the orbit)
- Level 3 orbit
- Levels 2 and 3 skull base and cranial vault

In addition, practical applications of the present system are considered with specific regard to radiological and diagnostic issues as well as electronic documentation using a software solution. A large case collection is made available electronically on the AOCMF website (www.aocmf.org/classification). Each presented case include selected diagnosis images, a description of identified fractures, as well as the fracture coding using the AOCOIAC (AO Comprehensive Injury Automatic Classifier) software solution.

Terminology

Routinely used clinical terms sometimes lack definition and are used in a more ambiguous way in contrast to international anatomical designations which are well illustrated in atlases and clearly referenced in an official nomenclature (FCAT, Federative Committee of Anatomical Terminology). The clinical terms often relate to important landmarks or substructures that bear no formal anatomical nameplates.

Both anatomical nomenclature and clinical terminology are used to identify the skeletal components. To preclude errors and misunderstanding in context with the level 2 CMF Classification, some ambiguous clinical expressions are presented in an appendix glossary.

Concluding Notes

Our consensus approach allowed bringing together the perspectives from different CMF specialties toward a common goal of having a comprehensive classification system.

As expected and accepted, this system is simplistic and imperfect. Some CMF surgeons will possibly reject it as being not detailed enough for their purpose, or not providing them the immediate clinical application they look for. Yet, the only way to make it a valuable tool for documenting CMF cases at a chosen level of details is to install it as a standard and aim for continuous improvement. This will promote more valid clinical research. With the use of refined diagnostic imaging techniques, the classification system will evolve and incorporate additional well-thought and validated diagnostic features we are not even dreaming of at present just as Le Fort at his time.

Presently, the authors encourage the whole community of surgeons involved in the management of CMF trauma to embark on the use of the proposed system, apply it in daily practice and research, and to push help its limit eventually to the benefit of their patients.

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Notes

Laurent Audigé, DVM, PhD and Carl-Peter Cornelius, MD, DDS, have contributed equally to this article and share lead

authorship. Members of the CMF Classification Group were: Core: Prein J. (Chair), Cornelius P., Buitrago-Tellez C. (radiologist), Kunz C., Frodel J., Rudderman R.; Condylar Process: Rasse M. (Chair), Neff A., Cornelius CP.; Skull Base: Matula C. (Chair), Di Ieva A., Shumrick K., Kellman B.; Scientific coordinator: Audigé L.

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