The Comprehensive AOCMF Classification System: Glossary of Common Terminology

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Terminology in the context of this series of tutorial papers outlining the comprehensive AOCMF classification system complies with special perspectives. The following list of terms refers to this particular thought process and is intended to clarify their use and meaning to facilitate comprehension, since many of the terms have no single agreed definition but a broad and inconsistent use.

Accuracy – Commonly: the degree to which a result, a specification, a calculation or a measurement is close to the true situation or actual value. Here: a validation parameter that indicates the proportion of fractures correctly classified, i.e., conforming to the true classification outcome.

AOCOIAC – Acronym for AO Comprehensive Injury Automatic Classifier software solution for classification and documentation of fractures in the human skeleton; now coming with a CMF module.

Articular (fracture) – Articular fractures involve a joint including articular surface, i.e the cartilage. In CMF articular fractures refer to the temporo mandibular joint, the TMJ, or (TMJ) and in particular to the condyle bearing part of the mandibular condylar process or the condylar head. This anatomic subregion is defined in reference to a tangent line anchored below the lateral pole zone. Articular fractures involving the condylar fossa are described as part of the skull base classification system.

Atrophy – Progressive decline or decrease in size up to the partial or complete wasting away of a body part or tissue due to age, disuse or disease. Here: alveolar process/ridge atrophy as a result of preinjury tooth loss and therefore loss of function. Progression of this local atrophic process leads to a loss of bone substance of the residual alveolar ridge (reduction of vertical and transverse external dimension).

Bone Defect (traumatic) – Discontinuity in the completeness of skeletal bony structures (Latin defectus = lack) caused by voids in bone substance or missing fragments in contrast to surgical bone resection or pathological bone defects from infection, cysts, tumor infiltration and metastases.

Bone Loss (traumatic) – Non-traumatic bone loss is commonly associated with osteoporosis, osteopenia or periodontal disease, i.e., decrease in bone density bone or resorption of the alveolar bone around the teeth. Here: Traumatic bone loss is used analogous to traumatic bone defects and appears as one feature to describe fracture morphology.

Boundary – Outer margin encompassing an anatomic region or subregion in its entire extent or full circumference, respectively.

Capitular – Relating to a capitulum (Latin: Capitulum = small articular head or small rounded eminence on the end of a bone). Here: Capitulum mandibulae.

CBCT – Acronym for Cone Beam Computed Tomography, which is an imaging modality that is applied in dental radiology and for CMF diagnosis and treatment planning. As the name implies the X-ray bundle in CBCT technology is forming a cone.

Classification System – A proposed or established system or systematic arrangement of categories, groups or classes distinguished by definite criteria into which things, information, documents, etc. may be allocated. The number of categories and the complexity of the structure of a fracture classification system relate to the precision level and

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clusters. A typical classification system in facial skeleton trauma is the Le Fort fracture system.

Classification Process – The step-by step sequence or prescribed workflow of analysis according to a pragmatic concept to obtain an assignment into a respective category or code. A diagnostic procedure can be understood as such a process; in the context of fracture classification it defines parameters including the type of information used (e.g., a radiograph or CT scan), the timing (e.g., post-trauma), how the information is read and processed (e.g., using a software) and by whom (e.g., an experienced CMF surgeon).

Comminution – Originally an industrial term for an act or process in which solid materials are reduced in size by crushing, grinding or other techniques into small fragments. Comminution as a term to describe a fracture pattern is no longer supported by the AO Foundation. The terms "comminuted" and "comminution" should not be used anymore since they are inappropriate as they refer to an action rather than a post-injury static-state. Instead the choice is for more specific terms such as "complex" or "multifragmentary" fracture. Fractures commonly referred to as "comminuted" in the CMF specialty are considered as fractures with "major fragmentation" (Grade 2) in the CMF classification system.

Compartment – a space, chamber, or separate room into which a larger area can be divided, e.g., orbital compartment enclosed in the honeycomb framework of the midface (cf. anatomical compartment).

Complex Fracture – Complex fractures are fractures with a high grade of fragmentation (see "fragmentation").

Confined (**fracture)** – Fracture exclusively located within one defined topographical region, and not extending into the adjoining region (e.g., transgressing transitional zones in the mandible).

Dentition – the type, number and arrangement of teeth in an individual. The secondary or permanent dentition in the dental arches (mandible and maxilla) of human adults consists of different types of teeth, including incisors, canines, premolars and molars. The teeth in the dental arches (mandible and maxilla).

Diacapitular Fracture – The term diacapitular fracture is often used synonymously with intracapsular fracture or fractures through the head of the condyle. Condylar head fractures commonly run in a sagittal plane and run from latero-cranial into a medio-caudal direction. Most of the fracture lines involve the articular surface and the medial aspect of the condylar neck inferior and outside the joint capsule. Thus the concept of intracapsular fractures is anatomically inappropriate and should be avoided.

Depression/Depressed Skull Fracture – A type of fracture at the base of the skull or cranial vault with fragments displaced inward toward the cranial cavity carrying the risk of placing pressure on the brain or producing hemorrhage and or crush of brain tissue.

Diastasis/Diastatic Fracture – A diastasis (Ancient Greek = "Separation") is a large or forcible separation of normally joined bony parts. Common use: separation of two normally adjacent bones which lack a true synovial joint without a fracture. Here: gapping between either two main bony fragments, or several bone pieces due to a fracture. Diastatic fractures with widening of the cranial sutures (sutural diastasis) usually affect infants and young children under three years of age. These fractures occur if the fracture lines transverse one or more sutures as long as the sutures are not fused.

Displaced Fracture – A fracture in which the fragments have moved apart, so that the bony ends or the entire fragments are not lined up in the preinjury position. In a non-displaced fracture, the fragments may have moved however maintain their original alignment.

Displacement – Feature of the fracture morphology that describes the difference between the initial position of a bone and the post-injury position of its fragments, i.e., the loss of alignment. Thus it characterizes a fracture in addition to its topographical location. The direction and extent of displacement of fracture fragments is distinguished in terms of degree of angulation, rotation, loss of apposition, shortening and distraction.

Displaced Fracture of the Condylar Process – Displacement of the condylar process after a fracture at variable height without or with concomitant dislocation of the condylar head out of the glenoid fossa.

Dislocation or **Luxation** (Latin: luxare = to dislocate) – Injury to the temporomandibular joint with complete exarticulation of the mandibular head out of the glenoid fossa. In a joint dislocation due to a fracture of the condylar process the condyle-bearing fragment and the caudal mandibular fragment (ramus stump) are usually displaced simultaneously. A partial dislocation is referred to as subluxation.

Division – One of the parts formed by partitioning, separating or cutting a whole into two or more parts, e. g., an anatomical division is a smaller zone within an area or region of the body or skeleton. A most common scheme is division/subdivision of the mandible into the ascending ramus and body division. A subdivision is a division following upon a previous division.

DVT – Acronym for Digital Volume Tomography. The German equivalent to Cone Beam Computed Tomography (see CBCT).

Edentulous/**Edentualism** – Jaw without teeth (partial or complete).

Entity – In the present context, the term is used to identify a distinct and independent unit or module with common features that has an objective or concrete reality (e.g., a regional fracture pattern).

Fracture – (Latin: frangere = to break, shatter; fractura = nominative feminine singular of fracturus = having been broken) a bone fracture is a break in the continuity of a bone. At this time the CMF classification deals with traumatic fractures only, while pathological fractures are deferred to a future version.

Fracture Course – A particular direction, route or pathway taken by a fracture.

Fracture Gap – Strictly speaking the empty space between fracture ends due to displacement. In colloquial use the 3-dimensional interspace of a fracture irrespective of its contact relationships and displacement.

Fracture Interface – Area of appositional contact between the surfaces of two fracture ends.

Fracture Line – Linear appearance of a bone fracture in conventional 2-dimensional radiographs or after surgical exposure the bony cortex representing the contours of the fracture ends or fragments. The location, direction, continuity and extent of one or multiple fracture lines further classify a fracture pattern (e.g., linear, oblique, wedge, non-fragmented, multifragmentary, etc.). Hairline fractures result from non-displaced bone fragments. In the era of 3-dimensional imaging the description of fracture lines seems somewhat outdated with the exception of thin laminar bone such as the midface or internal orbits. To refer to teeth in the line of fracture within the mandible however must sound like a misnomer nowadays since a volumetric relationship is implied. Reminder: In geometry a line has one dimension only.

Fracture Plane – (Latin: planum = flat surface) The term here is used with variable meaning: 1. Spatial relation of a fracture to the anatomic planes: sagittal, frontal/coronal, transverse, 2. Spatial dimension of the fracture end surfaces analogous to a fracture line, though in contrast to mathematics the planes in a fracture setting (versus an osteotomy plane) do not have a flat 2-dimensional surface, but a rough, jagged or mountainous cover in 3 dimensions.

Fracture Mapping – making a fracture map. Fracture mapping may be done in various ways: in a cartographic style or by superimposition of fracture patterns of several patients onto an anatomic template in statistical analysis for compilation of a frequency map or - as here - by drawing an individual fracture configuration into a classification scheme.

Fragment – (Latin: fragmentum = piece broken off, remnant) A single part or piece broken off or detached, i.e., a bone fragment is a broken single piece of a bone. (cf. segment)

Fragmentation – Process of producing fragments. For the purpose of this CMF classification fragmentation is used as a collective term to describe a feature of fracture morphology. Thus it refers to the extent to which a fracture is made up of main fragments - with or without intermediate fragment(s) - including their variation in size and relative position. A fracture may be classified in terms of a non-fragmented or fragmented composition and characterized by a minor or major fragmentation grade.

Hemimandible – One mandibular half. The two hemimandibles fuse at the midline by a vertical symphysis to form a single bone unit. Each hemimandible consists of a horizontal body carrying the ascending ramus as posterior vertical extension.

ICM – Acronym for Intermediate Central Midface (see Level–2 Midface Module)

Impaction/Impacted Fracture - Condition of being blocked or wedged in or pressed together. In an impacted fracture one fragment is firmly locked into another so that the fragments behave as a single unit. The diagnosis of an impacted fracture results from combined clinical and radiological assessment.

IOB – Acronym for Internal Orbital Buttress. The IOB corresponds to a boundary running in sagittal direction between the orbital floor and the medial wall (synonyms: inferomedial orbital strut or inferomedial orbital transition zone). It is a bony strut reinforced by the basal (or ground) lamella of the ethmoid bulla, that can be easily identified in coronal CT scans. Quite frequently lamellar orbital floor fractures are hinged at the IOB. -

LCM – Acronym for Lower Central Midface (see Level–2 Midface Module).

Le Fort Hemifracture – Fracture limited to one half of a Le Fort level, either hemi Le Fort 1, hemi Le Fort 2, hemi Le Fort 3 or any combination thereof in one half of the midfacial skeleton.

Luxation – According to its Latin meaning this term is used for "dislocation" in German speaking countries, what often causes confusion.

Module/Modular – (Latin: modulus, diminutive of modus = *measure*; scale) a self-contained structural (sub-) component, a subset or constituent elements of a single larger system. The CMF classification system consists of anatomic modules each of which is further specified by the precision level.

Multifragmented/Multifragmentary fracture – A fracture with more than one fracture line so that there are one or more intermediate fragments. Hence a multifragmentary fracture encloses wedge and complex fractures.

Neck/Neck of Condylar Process – Here: a narrow/ constricted and elongated stretch of bone. The condylar neck joins the condylar head to the base of the condylar process in the mandible (For more details and topographic borderlines see: Condylar Process Fractures Level-3).

NOE – Acronym for Naso-Orbito-Ethmoidal.

Notch/Mandibular Notch – An indentation/Concave indentation at the superior end of the ascending ramus of the mandible (Incisura mandibulae) between the coronoid and condylar processes (cf. other examples: coronoid notch, supraorbital notch, pterygomaxillary notch, etc.).

Palate – Roof of the oral cavity separating it from the nasal cavity. It is divided into the immovable hard palate anteriorly and the movable soft palate or velum posteriorly. The osseous shelves of the hard palate are formed by the small transverse portion of the premaxilla, the two palatine processes of the maxillae and the two plates of the palatine bones.

Palatine Bone – Each palatine bone has a horizontal and a perpendicular plate that vaguely resemble an L-shape. The horizontal plate forms the posterior portion of the hard palate. The perpendicular plate contributes to the lateral wall of the nasal cavity and the orbital floor. The upper end of the perpendicular plate carries the orbital process that

projects upwards and outwards and is forming the most posterior portion of the orbital floor.

Parasymphysis/Parasymphyseal Mandible – Mandibular subregion between the lateral surface of the canine roots and the mid-sagittal section. This CMF classification does not differentiate a parasymphyseal from the symphyseal subdivision. Both (right and left) parasymphyseal subdivisions are merged under the heading of symphysis.

Partition – State of being divided or separated into parts; a part, share or section into which something has been divided. A structure marking off an area, a cavity or a space, such as a ridge, wall, septum or other barrier. The term partition includes the idea to assign or allot a part subsequent to division.

Pole Zone of the Condylar Head/Lateral and Medial Pole Zone – The condylar head of the mandible can be conceived as an elongated spheroid or a prolate ellipsoid of revolution. The latero-medial dimension or the major transverse axis of this geometrically simplified condylar head is approximately twice as big as the antero-posterior dimension or the minor axis. The major axis ends in two fixed points on the lateral or medial surface. Each of the points (= poles) lies within the center at the top of one of the convex ends of the spheroid or condylar heads, respectively. The curved surface area in the proximity of the pole which is capping the lateral or medial condyle is called the pole zone. To delineate the vertical height of the lateral pole zone its circumference is outlined by a circle of the best of which the diameter is measured. Sagittal fractures through the lateral pole zone are commonly associated with loss of vertical height of the mandibular ramus (cf. diacapitular fracture).

Posterior Ledge – Intact bony remnant in the posterior portion of the orbital floor subsequent to a fracture that equates to the orbital process of the palatine bone (see: palatine bone).

Precision/Precision Level – Commonly: precision is the reproducibility or repeatability of a measurement system, i.e., the degree to which repeated measurements under unchanged conditions show the same results. The term precision level is applied rather colloquially here to refer to the various degrees of elaboration or the richness of detail of the anatomic classification modules (level of refinement).

Ramus Height (Syn: vertical ramus height) - vertical dimension of the posterior border of the ascending ramus including the condylar process.

Reference Standard Classification Process - An accepted practical classification process that is most likely to record the truth, or the essence of a fracture. An excellent (perfect or almost perfect) reference standard is referred to as a gold standard.

Region/Anatomic Region – (Latin: regiō, from regere = to govern, to rule, to direct) Large continuous area or space (of the body) having either natural or arbitrarily assigned boundaries or having definable characteristics. A subregion is a conceptual subdivision or subunit of a region.

Reliability – Extent to which the same measurement tool produces the same results between repeated measures over different time points, or different observers. Here reliability stands for a validation parameter that measures to what extent codings from repeated applications of the CMF classification process between raters (inter-rater reliability) or by the same rater (intra-rater reliability or test-retest reliability) on the same fractures agree.

Segment – (Latin: segmentum = a piece cut off, from secare = to cut) Portion of a larger body. Segment may mean: any of several parts or pieces that fit together with others to constitute a whole object.

Simple Fracture – A fracture with a single fracture plane (i.e., single perceived line on 2D images) producing two main fracture fragments.

Site – (Latin: situs = position, arrangement from *sinere, situs, to leave, allow* to be) Here: place, position or location in terms of anatomical or surgical site.

Subcategory – A subclass within a classification category or a secondary or subordinate category. A subcategory reflects some important characteristics representing a refinement of the classification system for fractures within the whole concerned category.

Subcondylar – Variable usage: area inferior to the condylar head or inferior to the entire condylar process. To exclude confusion the term subcondylar is not applied in this CMF Classification.

Symphysis/Symphyseal – The mandibular symphysis (symphysis menti) is a junction line between the hemimandibles marked by a vertical ridge on the anterior bone surface that is conveying into the mental protuberance inferiorly. Individual authors refer the symphysis to the narrow zone between the medial surfaces of the roots of the central lower incisors. Here symphysis designates a subregion of the anterior mandible bounded in between the lateral root surfaces of the canines (Cf. parasymphysis).

TMJ – Acronym for Temporo-Mandibular-Joint

Topography/Topographical Anatomy – anatomy based on regions or divisions of the body and emphasizing the relations between various structures (muscles and nerves and arteries etc.) within specific regions.

Transition/Transitional Zone – Two inferred zones in each hemimandible for the allocation of fractures to either one or both of the adjoining regions: anterior transition zone = between the symphysis/parasymphysis and the anterior body; posterior transition zone = between the body and the angle/ramus region. The transitional zones are conceived as imaginary vertical strips in the width of the lower canine and the third molar. Fractures crossing a transitional zone are allocated to both juxtaposed regions. A fracture course completely running within a transition zone is allocated to the adjoining posterior region. A fracture entering a transitional zone from a region posterior to is allocated to the respective posterior region. Mutas mutandis this applies for fractures extending a transitional zone from an anterior region.

UCM – Upper Central Midface (see Level–2 Midface Module).

Unit/Anatomic Unit/Subunit – One of several undivided basic elements, single structures or distinct entities that are integrated into a larger whole. An anatomic unit here refers to an elementary structural or functional constituent of the human body, such as the mandible. A subunit forms a discrete part of a more comprehensive unit.

Validity/Valid (Latin: validus = strong) – Addresses the extent to which a concept truely corresponds to the real world. Accordingly the validity of an assessment or measurement is considered the degree to which the tool or test is able to measure what it claims to measure (cf. Reliability).

Validation – A measurement system is designated *valid* if it is both *accurate* and *reliable,* as well as if it meets the purpose for which it has been developed. Classification validation is not only related to the defined system itself (the relevance of chosen categories and subcategories), but also the process of coding (classification process). Fracture classification categories must support the clinical decision process and have prognostic value. It is useless to define categories that cannot be distinguished by observers in reality due to a lack of a sufficiently reliable and accurate classification process.

Wedge Fracture – Multifragmentary fracture type with a third intermediate wedge-shaped fragment in which, after reduction, there is some direct contact between the two main fragments, e.g., a mandibular fracture of Grade-1 minor fragmentation that does not extend over the full mandible height.

Zone – Any continuous tract, **area** or region that differs in some respect or is distinguished from adjoining parts by a distinctive feature or characteristic or within which certain distinctive circumstances or conditions prevail (cf. Fracture zone, transition/al zone, lateral condylar pole zone, etc.).

Zygomatico-Maxillary Ensemble – Conjunction of bony elements including the zygoma and its adjacent maxillary or orbital structures (antrum, orbital walls, rim) that are commonly involved in a typical lateral midface fracture. This term is preferred to zygomatico-maxillary complex, to avoid infelicitous wording such as complex zygomatico-maxillary complex fractures.