Journal of Cranio-Maxillo-Facial Surgery 53 (2025) 999–1008

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Facial trauma management: A nationwide data collection on practice patterns and patient care in oral and maxillofacial surgery in Germany

Philipp Becker[a,b,*], Frederic Bouffleur[c], Diana Heimes[b], Daniel G.E. Thiem[b], Lukas B. Seifert[d], Andreas Neff[e], Jörg Wiltfang[f], Max Heiland[g], Marco Kesting[h], Anne-Kathrin Bär[a,b], Alexander-N. Zeller[i,j], Andreas Pabst[a,b]

[a] *Department of Oral and Maxillofacial Surgery, University Medical Center Mainz, Augustusplatz 2, 55131, Mainz, Germany*
[b] *Department of Oral and Maxillofacial Surgery, German Armed Forces Central Hospital, Rübenacherstr. 170, 56072, Koblenz, Germany*
[c] *Department of Oral and Maxillofacial Surgery, University Hospital Heidelberg, Im Neuenheimer Feld 400, 69120, Heidelberg, Germany*
[d] *Department of Oral and Cranio-Maxillofacial Surgery, University Hospital Basel, Spitalstr. 21, 4031, Basel, Switzerland*
[e] *Department of Oral and Maxillofacial Surgery, University Hospital Marburg, Baldingerstr., 35043, Marburg, Germany*
[f] *Department of Oral and Maxillofacial Surgery, University Hospital Kiel, Arnold-Heller-Str. 3/Haus 26, 24105, Kiel, Germany*
[g] *Charite – Universitatsmedizin Berlin, Corporate Member of Freie Universitat Berlin and Humboldt-Universitat zu Berlin, Department of Oral and Maxillofacial Surgery, Augustenburger Platz 1, 13353, Berlin, Germany*
[h] *Department of Oral and Maxillofacial Surgery, University Hospital Erlangen, Glückstr. 11, 91054, Erlangen, Germany*
[i] *Private Practice for Oral and Maxillofacial Surgery, Theaterstr. 61, 52062, Aachen, Germany*
[j] *Department of Oral and Maxillofacial Surgery, Hannover Medical School, Carl-Neuberg-Str. 1, 30625, Hannover, Germany*

A R T I C L E I N F O

Keywords:
Facial trauma
Oral and maxillofacial surgery
Head and neck surgery
Osteosynthesis
Survey
Germany

A B S T R A C T

This study aims to analyze facial trauma management, practice patterns, and patient care in Oral and Maxillofacial Surgery (OMFS) in Germany by using a dynamic online questionnaire with up to 54 questions. The survey, comprising single/multiple-choice and open-ended questions, was implemented via SurveyMonkey® and distributed to OMFS departments and surgeons in Germany. Data was analyzed anonymously and descriptively. Eighty-four OMFS departments and surgeons participated, revealing diverse facial trauma management. Monthly facial trauma patient volumes ranged from 0 to 10 (37.8 %) to more than 75 (4.88 %). Computed tomography (CT) was the primary imaging modality (82.05 %), supplemented by cone-beam CT and panoramic radiographs (56.41 % each). Orbital floor reconstruction primarily involved transconjunctival access (42.86 %) and pre-fabricated titanium meshes (69.01 %). Champy mini-plate osteosynthesis mainly managed mandibular angle fractures (51.47 %). Variability persists in the management of mandibular condylar process fractures in Germany. While a significant number of participants favor conservative treatment for condylar process fractures overall (26.87 %), the rate of surgical intervention for condylar head fractures is notably higher than international standards (59.42 %). Endoscopic techniques were rare (18.84 %). The management of standard thrombosis prophylaxis and perioperative antibiotic administration varied. Differences in specific facial trauma management were identified and assumed to be based on internal experiences and structural and personnel resources.

1. Introduction

Facial trauma management is a central component of Oral and Maxillofacial Surgery (OMFS), addressing injuries from falls, interpersonal violence, traffic accidents, war-related trauma, sports injuries, and others. These injuries often involve not only soft tissue damage but fractures of the mandible, maxilla, zygomatic complex, orbital walls, and other facial bones (Zimmerer et al., 2016; Goedecke et al., 2019; Birkenfeld et al., 2020; Neff and Kolk, 2023; Bettag et al., 2024; Meisgeier et al., 2024). A recent epidemiological study of over 374,000 facial trauma-related procedures registered in Germany (2005–2022) reported an incidence rate of OMFS trauma-associated procedures of 25.1 per 100,000 person-years, with men exhibiting a markedly higher risk (gender ratio 2.8:1). While incidences among children and young adults show a decline, there is a significant rise in older populations over 60 years (Meisgeier et al., 2024). Besides their impact on patients' quality

* Corresponding author. Department of Oral and Maxillofacial Surgery, University Medical Center Mainz, Augustusplatz 2, 55131, Mainz, Germany.
E-mail address: beckerph@uni-mainz.de (P. Becker).

https://doi.org/10.1016/j.jcms.2025.03.013
Received 7 February 2025; Received in revised form 24 February 2025; Accepted 14 March 2025
Available online 2 April 2025

of life, these injuries place a substantial financial burden on healthcare systems (Schneider et al., 2015; Zhang et al., 2024). Successful treatment of facial trauma requires a combination of surgical expertise, individualized patient care, and the application of advanced techniques and materials. The primary objective is to achieve optimal restoration of both form and function, to prevent subsequent damage, and to improve the overall post-traumatic outcome of the patient (Neff and Kolk, 2023; Li et al., 2024). The initial evaluation of a trauma patient includes a detailed patient history and systematic clinical examination, followed by imaging to confirm suspected fractures and characterize fracture patterns. Advanced three-dimensional imaging modalities, such as computed tomography (CT) and cone-beam CT (CBCT), have replaced traditional radiography due to superior diagnostic capabilities (Gart and Gosain, 2014; Crozet et al., 2023; Neff and Kolk, 2023; Bettag et al., 2024). These imaging techniques also enable virtual surgical planning, intraoperative navigation, and the design of patient-specific implants (PSI). Additionally, intraoperative imaging allows surgeons to evaluate fracture reduction before concluding the procedure (Heiland et al., 2005; Al-Moraissi et al., 2018; Gander et al., 2018; Hartmann et al., 2022; Ronde et al., 2023). Given the complex and often interdisciplinary nature of facial trauma, consultations with ophthalmology, otolaryngology, neurosurgery, and other specialties are frequently required (Pietzka et al., 2020). A wide range of treatment approaches is available for OMF fractures. The standard principle involves open reduction and internal fixation (ORIF) using various osteosynthesis methods and materials. For certain cases, non-surgical techniques such as closed reduction with external fixation remain valid alternatives, such as intermaxillary fixation (IMF). While foundational principles of diagnosis and treatment are widely accepted, controversies persist regarding the specific management of particular fracture types (Pietzka et al., 2020; Neff and Kolk, 2023; Lentge and Tavassol, 2024; Meisgeier et al., 2024). Mandibular condylar neck and head fractures remain a subject of ongoing debate. The choice between non-surgical treatment, e.g., with IMF, and ORIF, which restores pre-traumatic anatomy, involves complex decision-making. While ORIF offers potential advantages, including improved functional outcomes, it carries risks such as facial nerve injury. Conversely, non-surgical treatment may lead to long-term complications such as craniomandibular dysfunction (CMD), osteoarthritis, chronic pain, or ankylosis. These factors must be thoroughly weighed and discussed with patients (Brandt and Haug 2003; Eckelt et al., 2006; Kolk and Neff, 2015; Al-Moraissi et al., 2018; Kolk et al., 2020; Rößler et al., 2023; Kuna et al., 2024). Similarly, orbital floor fractures pose challenges due to the lack of consensus regarding reconstruction methods and perioperative management. Surgeons emavploy a variety of materials, including resorbable and non-resorbable implants, titanium meshes, and PSI, but treatment protocols differ widely. Such variability affects outcomes, including enophthalmos correction, orbital volume restoration, and long-term stability. Differences in surgery timing, approaches, and the extent of orbital exploration further contribute to these inconsistencies (Gart and Gosain, 2014; Zimmerer et al., 2016; Al-Moraissi et al., 2018; Birkenfeld et al., 2020; Bronstein et al., 2020; Hsu et al., 2022; Seifert et al., 2022).

This national survey aims to evaluate facial trauma management, practice patterns and patient care in OMFS in Germany, focusing on radiological diagnostics, treatment indications and concepts, surgical techniques, material usage, and perioperative care. It seeks to provide an overview of existing practices, identify opportunities for standardization, and highlight areas where further research is necessary to enhance patient outcomes.

2. Methods

A dynamic online questionnaire was developed to evaluate facial trauma management, practice patterns and patient care in OMFS in Germany. The completed questionnaire included up to 54 questions to cover a broad range of general and specific aspects of managing facial trauma and used a mix of single- and multiple-choice questions. General aspects included questions about, e.g., scope of activity, structural requirements, and case numbers. Specific elements included questions about, e.g., imaging techniques, zygomatic and orbital trauma, mandibular fractures, and perioperative management. For multiple-choice questions, participants were allowed to select more than one answer. Therefore, when calculating the percentage of participants who chose each answer option, based on the total number of participants who answered the question, the sum of the individual percentages may exceed 100 %. None of the survey questions were mandatory, allowing participants to skip any question. Supplemental material 1 overviews the questionnaire, including its questions and the corresponding answer options, the number of participants who answered each question and the respective distribution of answers for each question. The initial validation process was performed internally and involved test runs and discussions within the research team, then correcting and revising of individual questions and answer options. Next, external validation was performed by three highly experienced full-board-certified OMF surgeons and three OMFS residents from institutions known for their significant volume of trauma cases, who were not involved in developing the questionnaire. Any discrepancies or concerns raised during validation were resolved in joint discussions, and the questionnaire was adjusted accordingly. After completion, the questionnaire was implemented on the online platform SurveyMonkey® and subjected to another round of internal and external validation to verify its usability in digital format. The link to the survey was then emailed to 86 department heads of OMFS hospitals, and 916 private-practice OMFS surgeons registered on the German Association of Oral and Maxillofacial Surgery (DGMKG) mailing list. The email included a cover letter with general information about the survey objectives and an invitation to participate. The survey was deliberately sent only to department heads and private-practice OMFS surgeons, rather than to all staff members, to avoid including multiple responses from the same institution, which could introduce a potential selection bias. Reminder emails were sent to all departments and participants after 14, 28, 42 and 70 days to increase the response rate. After 90 days, the survey was closed, and the results were analyzed. Participation in this study was voluntary and maintained strict anonymity. Contact information was not stored for the survey. Strict care was taken to ensure no retrospective linking of contact details to the survey responses. The data was initially collected using the SurveyMonkey® platform and exported to Excel® (Microsoft Office; Microsoft Corporation, Redmond, WA, USA) for analysis. Data analysis was carried out using descriptive methods. Figures were created using GraphPad Prism® version 9 (GraphPad Software, Inc. Boston, MA, US). Language and grammar checks were performed using ChatGPT 4.0® (OpenAI, San Francisco, CA, USA) and Grammarly® (Grammarly Inc., San Francisco, CA, USA).

3. Results

3.1. General data

Eighty-four participants contributed to the survey, resulting in an overall response rate of 8.4 %. The average time to complete the dynamic online questionnaire was 11 min and 2 s. Most participants were affiliated with non-university hospitals (27; 32.14 %), followed by university hospitals (22; 26.19 %), outpatient clinics without 24-h monitoring (19; 22.62 %), hospitals with inpatient departments (11; 13.10 %), and outpatient clinics equipped with 24-h monitoring facilities (5; 5.95 %). Regarding duty time models, most participants (42 out of 80; 52.50 %) reported using a combination of on-site primary duty and on-call secondary duty. Systems involving exclusively on-call primary and secondary duties (11; 13.75 %) or primary duty only (11; 13.75 %) were equally common. Secondary duty-only models, where other departments often covered primary duties, accounted for 14 out of 80 participants (17.50 %), and 4 participants (5.00 %) reported on-site secondary duty systems. The composition of the primary duty service varied across participants. OMFS trainees with double degrees (medical and dental degrees) were the most frequently involved (43 out of 71; 60.56 %), followed by OMFS specialists (44; 61.97 %). OMFS trainees with medical degrees (36; 50.70 %) and dental surgery trainees (30; 42.25 %) were also commonly included. Trainees with dental degree contributed in 16 cases (22.54 %). Senior consultants (4; 5.63 %) and department heads (3; 4.23 %) were less frequently involved in primary duty services. More than half of the participants (44 out of 81; 54.32 %) worked in supraregional Trauma Centers certified by the German Society for Trauma Surgery (Deutsche Gesellschaft für Unfallchirurgie, DGU). Regional Trauma Centers were represented by 15 participants (18.52 %), local Trauma Centers by 2 participants (2.47 %), and 20 participants (24.69 %) indicated no certification.

The monthly volume of facial fracture patients treated varied widely among the participants. Most participants reported treating 11–25 cases per month (34 out of 82; 41.46 %), followed by participants managing 0–10 cases (31; 37.80 %). Higher patient volumes were less common, with 10 participants (12.20 %) treating 26–50 cases, 3 participants (3.66 %) managing 51–75 cases, and 4 participants (4.88 %) handling more than 75 cases monthly. Trauma bay management protocols also demonstrated variability. Nineteen of 71 participants (26.76 %) stated that the OMF surgeon was alerted early and present for all trauma patients with head and neck involvement. Twenty-five participants (35.21 %) applied this protocol only to patients with previously known injuries to the facial skeletal system or soft tissues. Another 13 participants (18.31 %) called OMF surgeons only after injuries were detected during trauma bay evaluation, while 14 participants (19.72 %) reported only secondary involvement after trauma bay treatment. Soft tissue management was predominantly assigned to the on-call OMF surgeon, with 40 out of 71 participants (56.34 %) indicating that their department treated all facial soft tissue injuries. Seventeen participants (23.94 %) stated that intraoral and functional or aesthetic extraoral injuries were managed. Eleven participants (15.49 %) limited treatment to functional and aesthetic zones, while 3 (4.23 %) treated intraoral injuries exclusively. Dental trauma management was primarily handled by the on-call OMF surgeon in 60 out of 76 facilities. (78.95 %). Fewer cases were managed by the dental emergency service (10; 13.16 %) or external hospitals and practices (6; 7.89 %). Regarding training in facial fracture management, most participants (40 out of 65; 61.54 %) reported that training begins in the first year of residency. A smaller proportion indicated that training starts in the second year (18; 27.69 %) or the third year (4; 6.15 %). Training commencing at the specialist level was rare, reported by only 3 participants (4.62 %), while no participants indicated starting fracture management training in the fourth or fifth year of residency.

3.2. Imaging techniques

Imaging methods used in suspected facial skeleton fractures varied among participants, with CT being the most commonly employed modality (64 out of 78; 82.05 %). Dental X-rays, such as panoramic radiographs and CBCT, were equally utilized (44; 56.41 %), while conventional X-rays, including Clementschitsch projections, were less frequently used (14; 17.95 %). Intraoperative imaging capabilities were reported by 49 out of 81 participants (60.49 %), while 32 participants (39.51 %) indicated its absence. Among participants using intraoperative imaging, it was primarily for foreign body localization (28 out of 43; 65.12 %) and complex fractures involving multiple regions of the facial skeleton (19; 44.19 %). It was also employed for orbital floor reconstructions with titanium meshes (10; 23.26 %), fractures of the condylar neck (6; 13.95 %), fractures of the condylar head (4; 9.30 %), and condylar base fractures (2; 4.65 %). Only 2 participants (4.65 %) used intraoperative imaging as a standard for every trauma-related procedure. Intraoperative navigation systems were available in 42 out of 81 participants (51.85 %), while 39 participants (48.15 %) reported not having this technology. Among those using navigation, it was most frequently applied for foreign body localization (30 out of 40; 75.00 %) and complex fractures involving multiple facial regions (20; 50.00 %). Orbital floor reconstructions with titanium meshes accounted for 19 cases (47.50 %), while simple displaced fractures, such as zygomatic fractures, and standard use for every trauma-related procedure were less commonly reported (1 case each; 2.50 %). When clinical examination suspected facial bone fractures in children under 13 years of age, CBCT was the most frequently used method (26 out of 65; 40.00 %), followed by CT (22; 33.85 %) and dental X-rays such as panoramic radiographs (12; 18.46 %). Magnetic resonance imaging (MRI) was used in 5 cases (7.69 %), while none of the participants reported using conventional X-rays or omitting imaging entirely.

3.3. Zygomatic and orbital trauma

Participants preferred a surgical approach for treating zygomatic (tripod) fractures. Treatment exclusively via an extraoral approach was favored by 30 out of 71 participants (42.25 %), while 19 participants (26.76 %) preferred an exclusively intraoral approach whenever feasible. A combined approach involving intraoral and extraoral techniques was chosen by 22 participants (30.99 %). Referral of patients with orbital trauma to ophthalmology varied between different participants. The majority (40 out of 72; 55.56 %) refer every patient preoperatively and postoperatively, while 25 participants (34.72 %) reported referring patients due to symptoms such as visual impairment or diplopia. A smaller proportion of patients are only referred preoperatively (6; 8.33 %) or only postoperatively (1; 1.39 %) for consultation. For decompression of a retrobulbar hematoma, the most preferred surgical access was lateral canthotomy (34 out of 70; 48.57 %). Other approaches included access through the lower eyelid (20; 28.57 %), the upper eyelid (8; 11.43 %), and the transconjunctival route (6; 8.57 %). A transnasal endoscopic approach via the medial orbital wall was rarely used (2; 2.86 %). The indication for surgical treatment of orbital floor fractures was predominantly based on clinical signs such as motility disorders, visual impairment, or enophthalmos (61 out of 71; 85.92 %). Additional factors included defect size or degree of displacement (50; 70.42 %), imaging criteria such as soft tissue prolapse or rounding of the inferior rectus muscle (44; 61.97 %), and secondary factors like comorbidities or patient age (33; 46.48 %). Routine revision surgery for every orbital floor fracture was reported by only 7 participants (9.86 %), and delayed indication after swelling subsided was preferred by 8 (11.27 %). For surgical access to the orbital floor, the transconjunctival route was favored by most participants (30 out of 70; 42.86 %). Subciliary (17; 24.29 %), infraorbital (13; 18.57 %), and mediopalpebral (7; 10.00 %) approaches were also employed. Three participants (4.29 %) reported using other techniques (Fig. 1A). Regarding materials for orbital floor reconstruction, prefabricated titanium meshes were the most commonly used for extended defects (49 out of 71; 69.01 %) (Fig. 1C). PSI were primarily employed for secondary reconstructions (49 out of 71; 69.01 %) and anatomically complex dislocations (35; 49.30 %), with fewer participants using them for larger defects (20; 28.17 %) (Fig. 1D). Polydioxanone (PDS) membranes were favored for larger defects with sufficient bony support to apply the PDS membrane (45 out of 71; 63.38 %) and small defects (16; 22.54 %). Few participants reported using PDS membranes (3; 4.23 %) or titanium meshes (18; 25.35 %) infrequently (Fig. 1B). Secondary revision surgeries following orbital floor reconstruction were reported to occur in less than 1 % of cases by most participants (47 out of 69; 68.12 %), while 21 participants (30.43 %) indicated a revision rate between 1 and 5 %. Only 1 participant (1.45 %) reported a revision rate exceeding 20 %, and no participants indicated rates between 6 and 20 %.

3.4. Mandibular fractures

For minimally displaced fractures in the dentate mandible (e.g.,

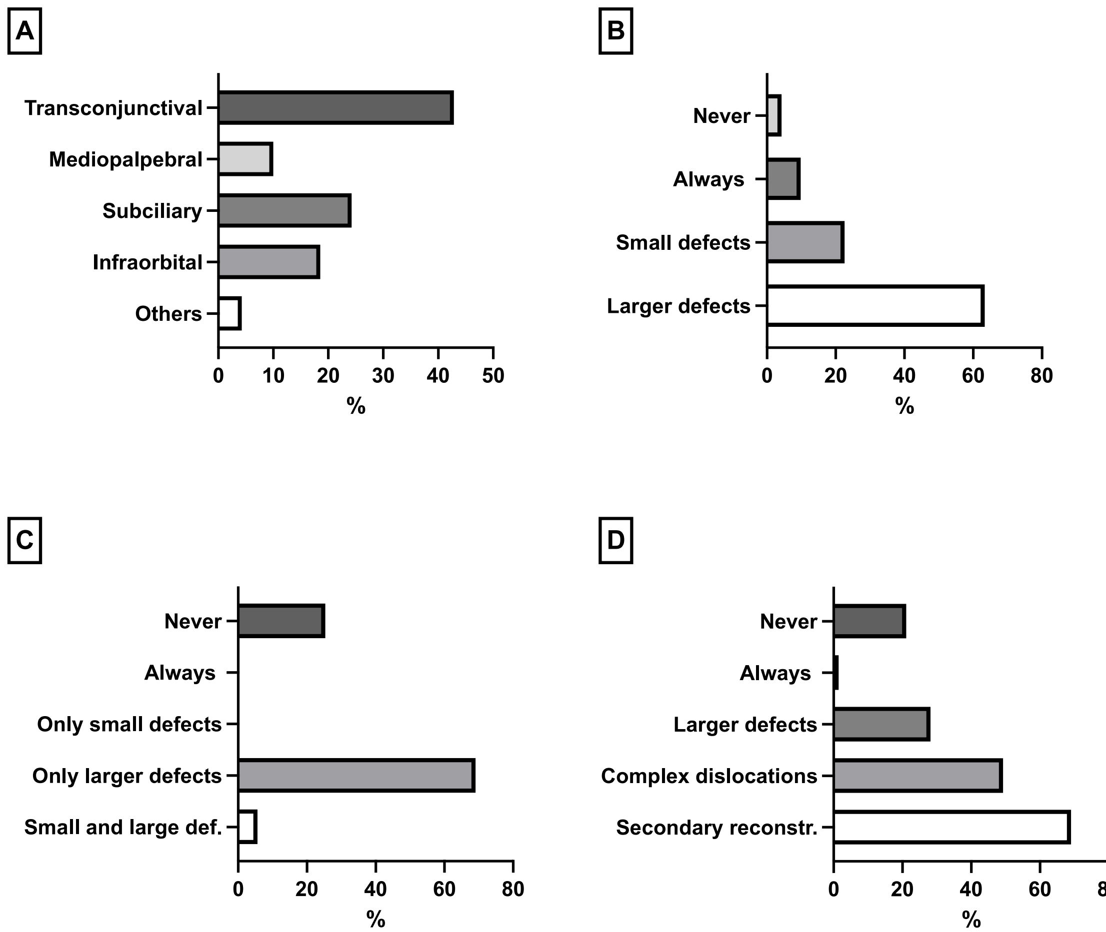

Fig. 1. Overview of the surgical approaches to the orbital floor **(A)** and the indications for various materials used in orbital floor reconstruction, including membrane **(B)**, prefabricated titanium mesh **(C)**, and patient-specific implants (PSI) **(D)**.

corpus, paramedian, or median fractures), 33.82 % (23 out of 68) of participants prefer immediate surgical treatment (ORIF), 30 (44.12 %) initial immobilization followed by later surgical treatment, and 22.06 % (15 out of 68) choose no initial immobilization with later surgical treatment. In cases of severely displaced fractures in the dentate mandible, immediate surgical treatment (ORIF) is favored by 73.53 % of the participants (50 out of 68), while 23.53 % (16 out of 68) prefer initial immobilization followed by later surgery, and 2.94 % (2 out of 68) opt for no initial immobilization with later surgery. Regarding incision techniques for fractures in the dentate mandible, 13.24 % (9 out of 68) of participants use a marginal incision, 61.76 % (42 out of 68) prefer a paramarginal stepped incision, and 25 % (17 out of 68) choose a paramarginal incision without a stepped design. For managing mandibular angle fractures, 51.47 % (35 out of 68) use one mini-plate according to Champy, 32.35 % (22 out of 68) employ two mini-plates, 4.41 % (3 out of 68) use a rigid osteosynthesis plate, and 11.76 % (8 out of 68) opt for specialized mandibular angle grid plates.

Forty-four out of 67 participants (65.67 %) treating mandibular condylar process fractures surgically, 26.87 % (18 out of 67) treating them conservatively, and 7.46 % (5 out of 67) referring patients to another clinic for surgical management. The decision to pursue surgical treatment is influenced by several criteria: degree of displacement/dislocation (89.71 %; 61 out of 68), observable occlusal and functional disturbances (83.82 %; 57 out of 68), fracture line height (57.35 %; 39 out of 68), comorbidities (47.06 %; 32 out of 68), and patient preference after discussing treatment options (67.65 %; 46 out of 68). For mandibular condylar base fractures, intraoral approaches are most frequently used (54.55 %; 36 out of 66), followed by angular (high submandibular) approaches (34.85 %; 23 out of 66), antero/transparotid approaches (33.33 %; 22 out of 66), and retromandibular (subparotid) approaches (30.30 %; 20 out of 66) (Fig. 2B). In the treatment of condylar neck fractures, the preauricular approach is the most common (54.55 %; 36 out of 66), followed by antero/transparotid (39.39 %; 26 out of 66), angular (27.27 %; 18 out of 66), intraoral (24.24 %; 16 out of 66), retromandibular (19.70 %; 13 out of 66), preauricular with temporal extension (18.18 %; 12 out of 66), and retroauricular (4.55 %; 3 out of 66) approaches (Fig. 2C). For condylar head fractures, the preauricular approach is again preferred by 68.25 % (43 out of 63), followed by preauricular with temporal extension (36.51 %; 23 out of 63), antero/transparotid (12.70 %; 8 out of 63), retroauricular (12.70 %; 8 out of 63), retromandibular (11.11 %; 7 out of 63), intraoral (7.94 %; 5 out of 63), and angular (6.35 %; 4 out of 63) approaches (Fig. 2D). The preferred osteosynthesis techniques for mandibular condylar process fractures include the use of two mini-plates (68.66 %; 46 out of 67), specialized condylar plates such as the Delta plate (49.25 %; 33 out of 67), compression screws (5.97 %; 4 out of 67), and other methods (10.45 %; 7 out of 67) (Fig. 2A). Endoscopic treatment for mandibular condylar process fractures is not widely adopted, with only 13 out of 69 participants (18.84 %) reporting its use, while 56 (81.16 %) do not use this method. Condylar head fractures are treated surgically by 59.42 % (41 out of 69) of participants, while 40.58 % (28 out of 69) manage them non-surgically. Surgical indications for condylar head fractures include the degree of displacement/dislocation (82.05 %; 32 out of 39), observable occlusal and functional disturbances (82.05 %; 32 out of 39),

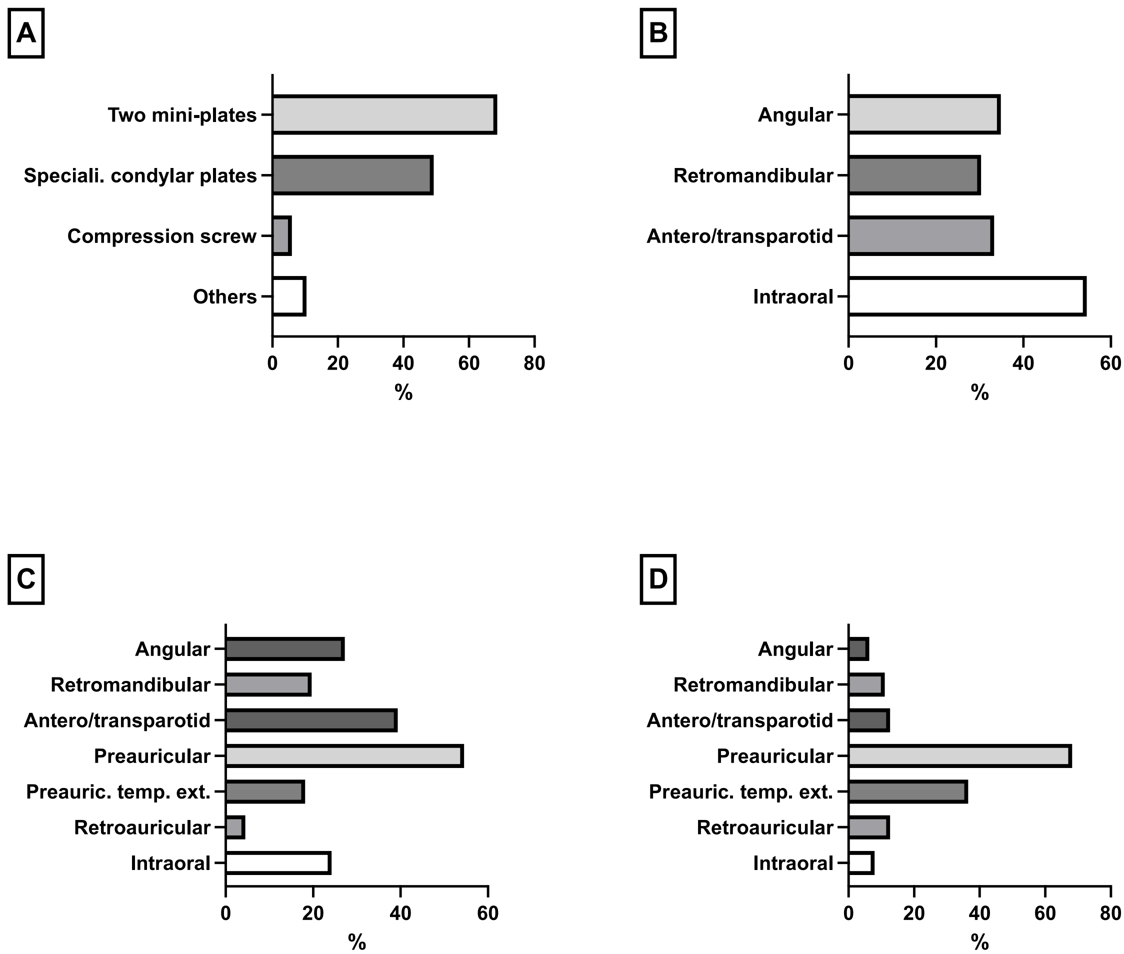

Fig. 2. Overview of the types of osteosynthesis used for condylar process fractures **(A)** and the surgical approaches for condylar base fractures **(B)**, condylar neck fractures **(C)**, and condylar head fractures **(D)**.

patient preference (76.92 %; 30 out of 39), and comorbidities (46.15 %; 18 out of 39). Regarding osteosynthesis material removal after mandibular condylar process fracture treatment, 31.25 % of participants (20 out of 64) only perform removal in cases of complications, 25 % (16 out of 64) do not generally recommend removal, 14.06 % (9 out of 64) advise removal, 12.5 % (8 out of 64) offer it as an option, 15.63 % (10 out of 64) base the decision on fracture type and patient comorbidities, and 1.56 % (1 out of 64) refer patients to another clinic for removal if necessary. Non-surgical treatment methods for mandibular condylar process fractures include the use of IMF screws (80.33 %; 49 out of 61), prefabricated splints (50.82 %; 31 out of 64), laboratory-made devices (19.67 %; 12 out of 64), and wire ligatures (18.03 %; 11 out of 64). Functional follow-up (e.g., physiotherapy) for these patients i s implemented until full rehabilitation in 30.65 % (19 out of 62) of cases, for six weeks in 19.35 % (12 out of 62), for four weeks in 19.35 % (12 out of 62), for 12 weeks in 4.84 % (3 out of 62), while 25.81 % (16 out of 62) do not provide functional follow-up. Lastly, orthodontic treatment is offered to patients with mandibular condylar process fractures by 22.22 % (14 out of 63) of participants, while 77.78 % (49 out of 63) do not refer these patients for orthodontic care.

3.5. *Perioperative management*

Standard thrombosis prophylaxis during hospital stays for facial trauma patients undergoing surgical treatment under general anesthesia was provided by 33 out of 63 participants (52.38 %), whereas 30 (47.62 %) reported not implementing it. Non-medication-based thrombosis prophylaxis measures, such as shortening preoperative immobilization, early mobilization, physiotherapy, and compression stockings, were used by 13 out of 34 participants (38.24 %). Low molecular weight heparins (LMWH) were the most frequently applied type of thrombosis prophylaxis (33 out of 34; 97.06 %), while unfractionated heparin (UFH) was reported by 1 participant (2.94 %). The initiation of thrombosis prophylaxis varied, with 9 out of 34 participants (26.47 %) starting immediately after hospital admission, 5 (14.71 %) preoperatively (≤24 h), 5 (14.71 %) perioperatively (1–2 h before surgery), and 15 (44.12 %) postoperatively. Regarding the duration, 20 out of 34 participants (58.82 %) continued prophylaxis until full mobilization, 12 (35.29 %) until discharge, and 2 (5.88 %) for 1–3 days. Antibiotic prophylaxis was always applied by 31 out of 64 participants (48.44 %) and selectively, based on factors such as fracture type, comorbidities, or wound contamination, by 32 (50.00 %). Only 1 participant (1.56 %) reported not using it. The most frequently used active ingredient was ampicillin/amoxicillin with a β-lactamase inhibitor (44 out of 63; 69.84 %), followed by cefuroxime (11; 17.46 %) and ampicillin/amoxicillin without β-lactamase inhibitors (3; 4.76 %). Clindamycin was reported by 1 participant (1.59 %) as a standard option and by another 1 (1.59 %) exclusively in cases of penicillin intolerance, while cefazolin was used in 1 case (1.59 %). Other active ingredients were mentioned by 2 participants (3.17 %).

4. Discussion

This survey aimed to provide a comprehensive overview of facial trauma management, practice patterns and patient care in OMFS in Germany.

Generally, there is widespread agreement in the literature and among participants that 3D imaging, such as CT (82 %) or CBCT (56 %), is essential in cases of suspected facial skeleton fractures. These modalities can be complemented by dental panoramic radiographs for fractures involving the jaws. While conventional X-rays hold historical significance, they are still utilized by approximately 18 % of participants (Neff and Kolk, 2023). The most critical clinical criterion for determining the treatment approach for orbital trauma was the presence of clinical symptoms such as motility disorders, visual impairment, and enophthalmos, reported by 86 % of participants. Additionally, imaging plays a pivotal role, with consensus in the literature that CT is the imaging modality of choice for orbital trauma (Gart and Gosain, 2014; Crozet et al., 2023; Bettag et al., 2024). Approximately two-thirds of participants indicated that both the orbital floor defect size or degree of displacement and further imaging criteria, such as soft tissue prolapse or rounding of the inferior rectus muscle, were significant factors in the decision-making process for surgical intervention. These findings align with a recently published survey on the management of orbital floor fractures in France by Crozet et al., which included 47 OMF surgeons, ophthalmologists, ENT specialists, and plastic surgeons. In that study, the primary criteria for intervention were clinical symptoms, followed by classic radiographic criteria (Crozet et al., 2023). Similarly, surveys by Christensen et al. (Christensen and Zaid, 2016) and Cohen et al., (2019) also emphasized these criteria, suggesting a consensus regarding the indications for surgical management of orbital floor fractures. Other authors have moved away from relying solely on classic radiological criteria, such as defect size, advocating instead for a more individualized assessment that considers defect key areas or structures and soft tissue involvement (Wevers et al., 2022; Bettag et al., 2024). This individualized approach is reflected in the survey results, as multiple answers were possible, and most participants indicated a combination of various criteria in their decision-making process. In contrast, less than 10 % of participants indicated that every orbital floor fracture undergoes surgery. A U.S. survey on the management of zygomatic fractures, which included 1611 OMF surgeons, plastic surgeons, and ENT specialists, reported that as many as 35 % routinely expose the orbital floor during the treatment of zygomatic fractures (Baylan et al., 2016). A routine surgical approach for each orbital floor fracture, including asymptomatic cases or those with minimal displacement on imaging, should be critically evaluated, as it may pose risks and lead to avoidable postoperative complications for the patient (Birkenfeld et al., 2020; Bettag et al., 2024). In comparison, it is also notable that more than 11 % of the participants in the current study stated that the indication for surgery should be postponed until the swelling had subsided 1–2 weeks after the trauma. This approach spares patients with swelling-related symptoms from overtreatment or unnecessary surgery. Conversely, recent literature suggests that early repair can be associated with significant resolution of motility disorders and diplopia compared to delayed procedures (Hsu et al., 2022). This delay, therefore, risks worse outcomes in patients whose symptoms are not solely due to swelling. In this context, an ophthalmologic evaluation can provide valuable support in decision-making. Nearly 99 % of participants recommended referring at least symptomatic patients with orbital floor fractures to an ophthalmologist, a finding consistent with previous surveys. Christensen et al. reported a lower rate (44.3 %) of systematic ophthalmologic examinations (Christensen and Zaid, 2016). Beyond aiding in surgical indication, such evaluations are essential for forensic reasons and for assessing direct ocular trauma, which occurs in approximately one-quarter of cases and could require immediate ophthalmologic intervention (Cook, 2002). Considering this fact, a potential discrepancy in care can be assumed, as only 55.6 % of participants refer every patient with orbital trauma to ophthalmology both preoperatively and postoperatively. This practice may lead to undetected (initially asymptomatic) direct ocular trauma, which could result in significant disadvantages for the patient, including potential visual impairment. The authors of this study recommend routine preoperative and postoperative ophthalmological consultation for every patient with orbital trauma.

One of the most severe complications in orbital trauma is a retrobulbar hematoma with affection and dysfunction of the optic nerve, which can lead to permanent vision loss if not promptly and adequately treated. Internationally, lateral canthotomy is often the standard method for acute reduction of intraorbital pressure (Lentge and Tavassol, 2024), which is consistent with the results of this study in which almost half of the participants reported lateral canthotomy also as their preferred method for relief of retrobulbar hematoma. However, this technique primarily provides indirect decompression of the hematoma, with a limited increase in orbital volume and, consequently, a restricted reduction in pressure. For this reason, direct evacuation of the hematoma via a transpalpebral approach through the upper or lower eyelid is increasingly recommended (Zimmerer et al. 2014a, 2014b; Yarter et al., 2023; Lentge and Tavassol, 2024). In this study, 40 % of participants identified this as standard method of managing retrobulbar hematomas. Once the decision for orbital floor reconstruction has been made, the specific treatment approach must be determined. Generally, the management of orbital floor fractures differs from the classic ORIF principle, which focuses on defect reconstruction using alloplastic materials, such as titanium plates. Previously, autologous bone, cartilage, or fascial grafts were commonly employed. However, no standardized national or international guidelines currently recommend different surgical approaches and specific materials for particular indications (Birkenfeld et al., 2020; Bettag et al., 2024). In this study, 47 % of participants preferred the transconjunctival approach, followed by subciliary (24 %), infraorbital (19 %), and mediopalpebral (10 %) surgical accesses. Similarly, other survey-based studies also favored the transconjunctival approach (Cohen et al., 2019; Crozet et al., 2023). However, studies from the UK, Canada, Australia and New Zealand indicated a preference for extraconjunctival approaches, highlighting significant international and interinstitutional differences (Courtney et al., 2000; Lynham et al., 2004; Aldekhayel et al., 2014). The advantage of the transconjunctival approach is the absence of a visible external scar (Raschke et al., 2013). However, it can be associated with a higher risk of postoperative entropion, whereas extraconjunctival approaches are more commonly linked to ectropion. Nonetheless, some studies report no significant differences in complication rates between various approaches to the orbital floor (Bronstein et al., 2020; Crozet et al., 2023). Regarding the multiple materials for orbital floor reconstruction, approximately 23 % of participants reported using a resorbable membrane only for minor defects. In comparison, 63 % used it for larger defects, provided sufficient bony support surface exists. Over one-quarter of participants do not use prefabricated titanium meshes, while 69 % apply it only for more extended defects. Conversely, 28 % already use PSI for larger defects. Additionally, 49 % of participants reported anatomically complex dislocations, and 69 % cited secondary reconstructions as indications for the use of. On the other hand, one-fifth of participants currently do not use PSI at all, despite some authors already referring to them as the "state of the art" because they can lead to a significantly higher precision of orbital reconstruction, especially in conjunction with intraoperative navigation (Zimmerer et al., 2016; Hartmann et al., 2022; Bettag et al., 2024). More than 50 % of the participants have access to intraoperative navigation systems, nearly half utilizing them for orbital floor reconstruction with titanium meshes. Additional indications include foreign body localization, reported by three-quarters of participants, and complex fractures involving multiple regions of the facial skeleton, cited by 50 %. In addition to intraoperative navigation, titanium mesh positioning can be verified using intraoperative imaging (Gander et al., 2018), performed by 23 % of participants. This imaging modality is available to 60 % of participants, with the primary indications being foreign body localization, followed by complex fractures involving multiple regions of the facial skeleton and fractures of the mandibular condylar process. Overall, intraoperative navigation and imaging are currently employed in German hospitals only for selected indications and do not represent a standard setup for every trauma case. This limited use is likely due to the increased planning and time required for these technologies. Management approaches for mandibular fractures remain diverse, with treatment ranging from surgical to conservative or combined strategies, depending on the indication. This decision depends on various factors, such as the exact location and type of mandibular fracture, the degree of displacement, the patient's comorbidities, dentition, and, not least, patient or clinician preferences (Nasser et al., 2013; Neff and Kolk, 2023). This variability is evident in responses to the question, "Based on which criteria do you decide on the surgical treatment of a mandibular condylar process fracture?". Nearly all potential criteria, such as patient preference, observable occlusal and functional disturbances, comorbidities, and degree of displacement and dislocation, were cited as indications by at least half of the participants, reflecting the multifactorial nature of treatment decision-making. This underscores that the factors influencing mandibular fracture management are highly individual. They are often too complex to be fully captured in one general questionnaire on OMFS traumatology. Therefore, this survey focused on specific questions deemed most relevant by the authors, beginning with the timing of surgical treatment for fractures in the dentate mandible area. Per definition, such fractures are classified as open fractures that typically require surgical treatment via ORIF. However, immediate emergency treatment is now generally reserved for complicated fractures with soft tissue injuries or severe displacement, provided that antibiotic prophylaxis and immobilization are ensured (Milic et al., 2021; Neff and Kolk, 2023). Severely displaced fractures are treated with immediate surgical intervention by nearly 74 % of participants, while over one-third prefer this approach even for minimally displaced fractures in the dentate mandible. Conversely, 44 % of participants initially immobilize minimally displaced fractures, opting for delayed surgical treatment, a strategy also considered standard by 24 % for severely displaced mandibular fractures. The preferred surgical approach for fractures in the dentate mandible area is the paramarginal stepped incision. Similarly, angle fractures are treated surgically to achieve at least early functional stability. Various osteosynthesis techniques are used for this purpose. For typical mandibular angle fractures, more than half of the participants favor mini-plate osteosynthesis, according to Champy, while one-third prefer fixation with two mini-plates. In contrast, 12 % routinely use specialized mandibular angle grid plates, which, like multiple mini-plates or rigid plates, are more commonly recommended for specific indications, such as cases involving the simultaneous removal of a wisdom tooth or cyst (Neff and Kolk, 2023). While there is consensus favoring ORIF for fractures of the mandibular symphysis, body, angle, ascending ramus, and condylar base, fractures of the condylar neck and head remain debated. The principle of conservative therapy for displaced or dislocated fractures of the condylar process lies in stabilizing the occlusion through muscle-guided adaptation and addressing occlusal disturbances via dentoalveolar extrusion, contrasting with ORIF, which aims for precise restoration of pre-traumatic anatomy. ORIF may offer better functional outcomes. However, its risks, such as facial nerve injury, must be weighed against the long-term complications of closed reduction, including CMD, osteoarthrosis, chronic pain, or ankylosis (Neff et al., 2014a; Kolk and Neff, 2015; Kolk et al., 2020; Ellis, 2024). On the question, "How are mandibular condylar process fractures managed at your clinic?" two-thirds of participants responded that these fractures are generally treated surgically. In contrast, 27 % of participants still manage mandibular condylar process fractures primarily non-surgically despite consensus-based absolute indications for surgical treatment being established. These include significant dislocation with loss of the condyle-disc-fossa relationship, severe displacement with marked angulation and/or pronounced vertical height loss, an extensive diastasis of fracture segments, and occlusion that cannot be restored through conservative treatment. These indications were confirmed by the study participants as crucial for the surgical treatment of condylar process fractures in general and also of condylar head fractures (Brandt and Haug 2003; Eckelt et al., 2006; Klatt et al., 2010; Neff et al., 2014b; Lal et al., 2023; Neff and Kolk, 2023). However, it must be noted that the surgical complexity and required expertise, particularly for multi-fragmented condylar head fractures, are not to be underestimated (Neff and Kolk, 2023). This is further highlighted by over 7 % of participants stating that they do not surgically treat condylar process fractures at their clinic and instead refer patients to another center. Additionally, over 40 % reported that they do not perform surgical management for condylar head fractures. Thus, conservative therapy still has got its place, particularly when the aforementioned surgical indications (e.g., in the case of minimally displaced fractures) are not present or if the patient declines surgery after a thorough consultation. The IMF method for non-surgical treatment can be applied in various ways. Some authors continue to favor traditional arch bars (reported by 51 % of participants in this study, with multiple answers possible), while others prefer bone-anchored IMF screws (reported by 80 %) (Bera et al., 2022; Rößler et al., 2023). Internationally recognized experts in the treatment of condylar process fractures are increasingly critical of the use of IMF screws, considering them only partially suitable for managing these fractures. While IMF screws stabilize the occlusion, they meet the requirements for a state-of-the-art approach only in cases of non- or minimally displaced fractures, where their role is limited to fragment stabilization and muscular occlusal alignment. However, they fall short of fulfilling the goals of optimal conservative therapy, which aims to restore occlusion through muscle-guided adaptation and to address occlusal disturbances via dentoalveolar extrusion (Rößler et al., 2023; Ellis, 2024).

Apart from indications, the surgical approach and choice of osteosynthesis are critical for treatment quality. More than half of the participants favored the intraoral approach for mandibular condylar base fractures. This approach can be performed with endoscopic assistance (Alagarsamy et al., 2023), with less than 19 % utilizing the endoscopic technique. For condylar neck fractures, the preauricular approach was preferred by over 50 %, followed by the antero/transparotid approach (39 %). Regarding condylar head fractures, nearly 70 % of participants used the preauricular approach, while only 37 % favored the preauricular approach with temporal extension, despite its significantly lower risk of facial nerve injury compared to the preauricular approach without temporal extension (temporary 8.5 %, permanent 0.5 % versus 16 % temporary, 4.2 % permanent) (Al-Moraissi et al., 2018; Neff and Kolk, 2023).

For this question, some surgical approaches were selected as responses that, in the authors' view, are technically unsuitable for managing condylar head fractures. This may point to a lack of experience among certain participants with this type of fracture. Conversely, these options should have been excluded from the response choices beforehand, which was not done, thereby diminishing the validity of this question.

As for the type of osteosynthesis chosen for mandibular condylar process fractures, two mini-plates (69 %) and specialized condylar plates (49 %) were most commonly selected. A recent meta-analysis found no significant differences between these osteosynthesis methods (Kuna et al., 2024). Condylar head fractures were the main indication for screw fixation alone. Removing osteosynthesis material in the mandibular condylar process remains even more controversial. Only 14 % generally recommended it, with an additional 13 % routinely offering it. Metal removal is most commonly performed only in cases of complications (31 %). However, specialized centers increasingly recommend removal to avoid short- and long-term adverse effects within the temporomandibular joint (Skroch et al., 2020; Reichert et al., 2025).

Overall, the reported management of condylar process fractures reveals striking discrepancies in the level of care, with two notable extremes. On one hand, 27 % of participants stated that they do not surgically manage condylar process fractures at all, which likely exceeds the international rates of conservative treatment. On the other hand, nearly 60 % of participants surgically treat condylar head fractures, a proportion significantly higher than the international standard, where condylar head fractures are predominantly managed non-surgically (Neff, 2019; Kolk et al., 2020).

Nearly three-quarters of participants recommend functional therapy (e.g., physiotherapy) for mandibular condylar process fractures, with most advising its continuation until full rehabilitation. A key advantage of surgical management is the ability to initiate early functional therapy immediately after achieving stable fixation, thereby minimizing the risk of complications associated with prolonged immobilization (Kolk and Neff, 2015; Kolk et al., 2020; Neff and Kolk, 2023). Fifty percent of participants indicated that they administer antibiotic prophylaxis depending on the fracture type, patient comorbidities, and degree of wound contamination. Conversely, over 48 % reported providing prophylaxis to all OMF fracture patients, typically using an aminopenicillin with a β-lactamase inhibitor or clindamycin in cases of penicillin intolerance. Specific antibiotic regimens were not addressed in detail in the survey. Milic et al., in their systematic review, recommend antibiotic prophylaxis for comminuted mandibular fractures but do not support its routine use for fractures of the upper or midfacial thirds (Milic et al., 2021). Currently, no clear guidelines exist, leaving decisions to individual cases. However, routine prolonged postoperative antibiotic prophylaxis for all OMFS patients should be avoided (Bartella et al., 2018).

A potential limitation of this study is the relatively low response rate of 8.4 %, which is consistent with other survey-based studies but may introduce response bias (Pabst et al., 2021; Ronde et al., 2023). It is conceivable that institutions with a particular interest in standardized treatment approaches were more likely to participate, potentially limiting the generalizability of the findings. Additionally, larger academic centers may be overrepresented, whereas smaller hospitals with more limited resources may have participated less frequently. This could lead to data bias, particularly regarding the availability of specialized treatment options such as intraoperative navigation or intraoperative imaging. Furthermore, this potential response bias might also contribute to the high proportion of respondents reporting surgical management of condylar head fractures. To improve response rates in future studies, alternative recruitment strategies could be implemented, such as personal advertising at annual congresses of professional societies (e.g. DGMKG), where representatives from nearly all institutions typically attend. Additionally, temporary tracking of institutional participation could allow targeted follow-ups via email, phone, or direct contact to encourage non-responders to participate. Addressing these aspects in future surveys could enhance data representativeness. However, OMFS trauma care in Germany is often provided within hospital settings, which may partly explain the overall low response rate. Notably, 49 out of 86 German OMFS university and non-university hospitals participated in the study, corresponding to a hospital response rate of 56.7 %. This high departmental participation provides representative insights into trauma management practices within German OMFS.

The use of self-reported, anonymized data introduces the possibility of recall bias. Furthermore, no survey can comprehensively address all aspects of highly individualized clinical cases and therapy concepts. While a more targeted questionnaire may have yielded higher specificity, it likely also resulted in a lower response rate. A potential methodological limitation of this study is that only a single, potentially averaged, perspective per institution was considered. Diverging evaluations—such as those based on insufficient personal experience—should ideally be excluded, as they could distort the results. Additionally, participation by multiple members from the same institution may introduce selection bias. However, this bias was mitigated by distributing the survey link exclusively to department heads, rather than to all staff members. Without addressing these factors, the findings may reflect the participants' knowledge rather than the actual care practices. Similarly, nonsensical responses (e.g., inherently unsuitable surgical approaches) should be identified and eliminated to ensure that the survey captures the true state of clinical practice rather than the individual, potentially limited, expertise or understanding of the respondents.

A logical next step, considering the limitations of this study, would be to expand the survey to a European and international level to identify established treatment standards that could potentially be integrated into German practice. Significant differences are expected across countries, particularly in specialty involvement. In Germany, maxillofacial trauma management is predominantly performed by board-certified OMF surgeons, who complete dual-degree training in both medicine and dentistry, followed by a five-year residency program. In contrast, this dual-degree requirement is not part of standard training in the USA and several European countries (UEMS, 2024). In addition, a French study reported that orbital floor fractures are commonly treated by ophthalmologists, ENT specialists, and plastic surgeons, too (Crozet et al., 2023), while a British study found that most maxillofacial trauma patients within their cohort were referred to ENT specialists rather than OMFS (Brucoli et al., 2020). Beyond specialty distribution, healthcare system differences significantly influence treatment patterns. In Germany, the use of PSI is reimbursed through additional payments, whereas in many other European countries, this is not the case, potentially limiting its use and affecting treatment quality. On the other hand, the use of PSI can reduce operative time, which may, in turn, lower overall costs (Sun and Fallah, 2022). Additionally, structural differences persist across Europe, with some countries lacking a standardized trauma care system (Hietbrink et al., 2024). Geopolitical factors must also be considered. The ongoing conflict in Ukraine has led to a distinct injury pattern, with a predominance of war-related maxillofacial trauma characterized by extensive soft tissue and bony defects. These injuries differ significantly from classical trauma mechanisms observed in peacetime, such as falls, interpersonal violence, traffic accidents, and sports injuries, necessitating adapted treatment strategies focused on reconstructive techniques and long-term rehabilitation (Sinyuk et al., 2025). Germany and the United States also differ in both the organization and execution of maxillofacial trauma care. In Germany, trauma cases are primarily managed in university and non-university hospitals with dedicated OMFS departments, whereas in the U.S., multiple disciplines, including OMFS, plastic surgery, ENT, and trauma surgery, contribute to care, particularly in Level-1 trauma centers (Holmgren et al., 2007). However, a significant portion of less severe maxillofacial trauma cases in the U.S. is also managed in private practices (Baylan et al., 2016). Healthcare system differences further impact treatment accessibility, as Germany's universal healthcare system ensures standardized care for all patients, whereas treatment in the U.S. may be influenced by insurance status (Shin et al., 2018; Rivera Perla et al., 2022). Standardization of care is driven by national and international organizations. In Germany, practice guidelines are primarily shaped by the German Society of Oral and Maxillofacial Surgery (DGMKG) and the Working Group of the Scientific Medical Specialty Societies (Arbeitsgemeinschaft der wissenschaftlichen medizinischen Fachgesellschaften, AWMF), while in Europe the European Association for Cranio-Maxillofacial Surgery (EACMFS) and in the U.S., the American Association of Oral and Maxillofacial Surgeons (AAOMS) and the American College of Surgeons (ACS) play central roles. Additionally, global organizations such as the Working Group for Osteosynthesis Issues (Arbeitsgemeinschaft für Osteosynthesefragen, AO Foundation), the International Bone Research Association (IBRA), and the Strasbourg Osteosynthesis Research Group (S.O.R.G) significantly influence OMFS trauma management through education, research, and the development of evidence-based treatment protocols. This already enhances the quality of care and, consequently, improves overall patient outcomes. Specific findings of this study highlight areas for potential optimization, such as the perioperative management of orbital floor fractures, e.g., ophthalmologic evaluation, which is not yet a standardized pre- and postoperative measure in all hospitals, the underutilization of surgical treatment for condylar process fractures in some institutions, which may lead to poorer functional outcomes, and the use of suboptimal surgical approaches for condylar process fracture management. Adjusting these practice patterns could significantly enhance patient outcomes.

5. Conclusion

This survey provides an overview of facial trauma management, practice patterns, and patient care in OMFS in Germany. Differences and similarities in specific aspects of facial trauma management were identified, which may be attributed to internal experiences, structural conditions, and personnel resources. The findings highlight the importance of 3D imaging in OMFS, while intraoperative navigation and imaging remain underutilized. Variability persists in managing mandibular condylar process fractures and orbital floor reconstruction with some marked discrepancies in surgical care standards in Germany, emphasizing the need for continued surgical education despite existing literature. This study underscores the necessity of further research and developing of national and international guidelines to standardize OMFS trauma care.

Ethical approval

No patients or neither patient data were included in this study.

Data statement

All data from this study are available in supplemental material 1.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work language and grammar checks were performed using ChatGPT 4.0® (OpenAI, San Francisco, CA, USA) and Grammarly® (Grammarly Inc., San Francisco, CA, USA). After using this tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Funding

No funding was received for this study. This study was not conducted as special, contractual, or grant-funded research by the German Armed Forces. It was not commissioned or conducted in cooperation with the German Armed Forces. The study does not reflect any opinion of the German Armed Forces.

Conflict of interests

None.

Acknowledgments

We thank the German Association of Oral and Maxillofacial Surgery (DGMKG), the board, the scientific working group (AKWi), and the head office for supporting this study. We also thank all colleagues participating in this study and Mrs. Daniela Weihrich from the DGMKG head office for excellent technical assistance.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcms.2025.03.013.

References

Al-Moraissi, E.A., Ellis, E., Neff, A., 2018. Does encountering the facial nerve during surgical management of mandibular condylar process fractures increase the risk of facial nerve weakness? A systematic review and meta-regression analysis. J. Craniomaxillofac. Surg. 46 (8), 1223–1231.

Alagarsamy, R., Lal, B., Arangaraju, R., Roychoudhury, A., Srivastava, R.K., Barathi, A., 2023. Endoscopic-assisted intraoral approach for mandibular condyle fracture management: a systematic review and meta-analysis. Oral Surg Oral Med Oral Pathol Oral Radiol 136 (5), 537–553.

Aldekhayel, S., Aljaaly, H., Fouda-Neel, O., Shararah, A.W., Zaid, W.S., Gilardino, M., 2014. Evolving trends in the management of orbital floor fractures. J. Craniofac. Surg. 25 (1), 258–261.

Bartella, A.K., Lemmen, S., Burnic, A., Kloss-Brandstätter, A., Kamal, M., Breisach, T., Hölzle, F., Lethaus, B., 2018. Influence of a strictly perioperative antibiotic prophylaxis vs a prolonged postoperative prophylaxis on surgical site infections in maxillofacial surgery. Infection 46 (2), 225–230.

Baylan, J.M., Jupiter, D., Parker, W.L., Czerwinski, M., 2016. Management of zygomatic fractures: a national survey. J. Craniofac. Surg. 27 (6), 1571–1575.

Bera, R.N., Anand Kumar, J., Kanojia, S., Mashhadi Akbar Boojar, F., Chauhan, N., Hirani, M.S., 2022. How far we have come with the management of condylar fractures? A meta-analysis of closed versus open versus endoscopic management. J. Maxillofac. Oral Surg. 21 (3), 888–903.

Bettag, S.A., Gellrich, N.-C., Lentge, F., Jehn, P., Korn, P., 2024. Jochbein- und Mittelgesichtsfrakturen sowie posttraumatische Orbitadefekte – primäre und verzögerte primäre Versorgung. Die MKG-Chirurgie 17 (1), 18–25.

Birkenfeld, F., Naujokat, H., Sengebusch, A., Wiltfang, J., 2020. Primärversorgungen orbitaler verletzungen. Der MKG-Chirurg 13 (3), 158–164.

Brandt, M.T., Haug, R.H., 2003. Open versus closed reduction of adult mandibular condyle fractures: a review of the literature regarding the evolution of current thoughts on management. J. Oral Maxillofac. Surg. 61 (11), 1324–1332.

Bronstein, J.A., Bruce, W.J., Bakhos, F., Ishaq, D., Joyce, C.J., Cimino, V., 2020. Surgical approach to orbital floor fractures: comparing complication rates between subciliary and subconjunctival approaches. Craniomaxillofac Trauma Reconstr 13 (1), 45–48.

Brucoli, M., Boffano, P., Romeo, I., Corio, C., Benech, A., Ruslin, M., Forouzanfar, T., Starch-Jensen, T., Rodríguez-Santamarta, T., de Vicente, J.C., Snäll, J., Thorén, H., Tarle, M., Dediol, E., Pechalova, P., Pavlov, N., Daskalov, H., Doykova, I., Kelemith, K., Tamme, T., Kopchak, A., Shumynskyi, I., Corre, P., Bertin, H., Goguet, Q., Anquetil, M., Louvrier, A., Meyer, C., Dovšak, T., Vozlič, D., Birk, A., Aničić, B., Konstantinovic, V.S., 2020. Management of maxillofacial trauma in the elderly: a European multicenter study. Dent. Traumatol. 36 (3), 241–246.

Christensen, B.J., Zaid, W., 2016. Inaugural survey on practice patterns of orbital floor fractures for American oral and maxillofacial surgeons. J. Oral Maxillofac. Surg. 74 (1), 105–122.

Cohen, L.M., Shaye, D.A., Yoon, M.K., 2019. Isolated orbital floor fracture management: a survey and comparison of American oculofacial and facial plastic surgeon preferences. Craniomaxillofac Trauma Reconstr 12 (2), 112–121.

Cook, T., 2002. Ocular and periocular injuries from orbital fractures. J. Am. Coll. Surg. 195 (6), 831–834.

Courtney, D.J., Thomas, S., Whitfield, P.H., 2000. Isolated orbital blowout fractures: survey and review. Br. J. Oral Maxillofac. Surg. 38 (5), 496–504.

Crozet, A., Lebranchu, P., Vabre, B., Paillé, C., Bourry, M., Corre, P., Bertin, H., 2023. Management of orbital floor fractures in France: results of a national online survey. J. Stomatol. Oral Maxillofac. Surg. 124 (3), 101389.

Eckelt, U., Schneider, M., Erasmus, F., Gerlach, K.L., Kuhlisch, E., Loukota, R., Rasse, M., Schubert, J., Terheyden, H., 2006. Open versus closed treatment of fractures of the mandibular condylar process-a prospective randomized multi-centre study. J. Craniomaxillofac. Surg. 34 (5), 306–314.

Ellis, E., 2024. GP3a - maloney lecture: how should intracapsular fractures Be managed? Open vs. Closed treatment: argument for closed reduction. 106th AAOMS Annual Meeting, Scientific Sessions and Exhibition 106.

Gander, T., Blumer, M., Rostetter, C., Wagner, M., Zweifel, D., Schumann, P., Wiedemeier, D.B., Rücker, M., Essig, H., 2018. Intraoperative 3-dimensional cone beam computed tomographic imaging during reconstruction of the zygoma and orbit. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology 126 (2), 192–197.

Gart, M.S., Gosain, A.K., 2014. Evidence-based medicine: orbital floor fractures. Plast. Reconstr. Surg. 134 (6), 1345–1355.

Goedecke, M., Thiem, D.G.E., Schneider, D., Frerich, B., Kämmerer, P.W., 2019. Through the ages-Aetiological changes in maxillofacial trauma. Dent. Traumatol. 35 (2), 115–120.

Hartmann, A., Kämmerer, P., Ortolano, L.C., Sagheb, K., Seiler, M., 2022. Customised products for orbital wall reconstruction: a systematic review. Br. J. Oral Maxillofac. Surg. 60 (5), e702–e711.

Heiland, M., Schulze, D., Blake, F., Schmelzle, R., 2005. Intraoperative imaging of zygomaticomaxillary complex fractures using a 3D C-arm system. Int. J. Oral Maxillofac. Surg. 34 (4), 369–375.

Hietbrink, F., Mohseni, S., Mariani, D., Naess, P.A., Rey-Valcárcel, C., Biloslavo, A., Bass, G.A., Brundage, S.I., Alexandrino, H., Peralta, R., Leenen, L.P.H., Gaarder, T., 2024. What trauma patients need: the European dilemma. Eur. J. Trauma Emerg. Surg. 50 (3), 627–634.

Holmgren, E.P., Bagheri, S., Bell, R.B., Bobek, S., Dierks, E.J., 2007. Utilization of tracheostomy in craniomaxillofacial trauma at a level-1 trauma center. J. Oral Maxillofac. Surg. 65 (10), 2005–2010.

Hsu, C.R., Lee, L.C., Chen, Y.H., Chien, K.H., 2022. Early intervention in orbital floor fractures: postoperative ocular motility and diplopia outcomes. J Pers Med 12 (5).

Klatt, J., Pohlenz, P., Blessmann, M., Blake, F., Eichhorn, W., Schmelzle, R., Heiland, M., 2010. Clinical follow-up examination of surgically treated fractures of the condylar process using the transparotid approach. J. Oral Maxillofac. Surg. 68 (3), 611–617.

Kolk, A., Neff, A., 2015. Long-term results of ORIF of condylar head fractures of the mandible: a prospective 5-year follow-up study of small-fragment positional-screw osteosynthesis (SFPSO). J. Cranio-Maxillofacial Surg. 43 (4), 452–461.

Kolk, A., Scheunemann, L.M., Grill, F., Stimmer, H., Wolff, K.D., Neff, A., 2020. Prognostic factors for long-term results after condylar head fractures: a comparative study of non-surgical treatment versus open reduction and osteosynthesis. J. Craniomaxillofac. Surg. 48 (12), 1138–1145.
Kuna, S.K., Jain, A., Kuna, V., 2024. Two miniplates versus three dimensional plate in management of mandibular condylar fractures: a systematic review and meta-analysis. Craniomaxillofac Trauma Reconstr, 19433875241252979.
Lal, B., Alagarsamy, R., Dhanasekaran, A., Roychoudhury, A., Sharma, S., Arivarasan Barathi, M., 2023. Does surgical treatment of mandibular condyle head (diacapitular) fractures provide better outcomes than closed treatment? - a systematic review and meta-analysis. Br. J. Oral Maxillofac. Surg. 61 (10), 647–658.
Lentge, F., Tavassol, F., 2024. Primärversorgung von Mittelgesichtsfrakturen. Die MKG-Chirurgie 17 (1), 10–17.
Li, Z., Meng, F., Jin, M., Kwon, H., Zhong, K., 2024. Factors affecting aesthetic results in patients undergoing craniofacial reconstruction following maxillofacial trauma. Am J Transl Res 16 (11), 6540–6551.
Lynham, A.J., Chapman, P.J., Monsour, F.N., Snape, L., Courtney, D.J., Heggie, A.A., Jones, R.H., McKellar, G.M., 2004. Management of isolated orbital floor blow-out fractures: a survey of Australian and New Zealand oral and maxillofacial surgeons. Clin. Exp. Ophthalmol. 32 (1), 42–45.
Meisgeier, A., Pienkohs, S., Dürrschnabel, F., Moosdorf, L., Neff, A., 2024. Epidemiologic trends in maxillofacial trauma surgery in Germany-insights from the national DRG database 2005-2022. J. Clin. Med. 13 (15).
Milic, T., Raidoo, P., Gebauer, D., 2021. Antibiotic prophylaxis in oral and maxillofacial surgery: a systematic review. Br. J. Oral Maxillofac. Surg. 59 (6), 633–642.
Nasser, M., Pandis, N., Fleming, P.S., Fedorowicz, Z., Ellis, E., Ali, K., 2013. Interventions for the management of mandibular fractures. Cochrane Database Syst. Rev. 2013 (7), Cd006087.
Neff, A., 2019. Open reduction and internal fixation in temporomandibular joint traumatology: current concepts and future perspectives. Stomatological Disease and Science 3, 2.
Neff, A., Chossegros, C., Blanc, J.-L., Champsaur, P., Cheynet, F., Devauchelle, B., Eckelt, U., Ferri, J., Gabrielli, M.F.R., Guyot, L., Koppel, D.A., Meyer, C., Müller, B., Peltomäki, T., Spallaccia, F., Varoquaux, A., Wilk, A., Pitak-Arnnop, P., 2014a. Position paper from the IBRA symposium on surgery of the head – the 2nd international symposium for condylar fracture osteosynthesis, marseille, France 2012. J. Cranio-Maxillofacial Surg. 42 (7), 1234–1249.
Neff, A., Chossegros, C., Blanc, J.L., Champsaur, P., Cheynet, F., Devauchelle, B., Eckelt, U., Ferri, J., Gabrielli, M.F., Guyot, L., Koppel, D.A., Meyer, C., Müller, B., Peltomäki, T., Spallaccia, F., Varoquaux, A., Wilk, A., Pitak-Arnnop, P., 2014b. Position paper from the IBRA symposium on surgery of the head–the 2nd international symposium for condylar fracture osteosynthesis, marseille, France 2012. J. Craniomaxillofac. Surg. 42 (7), 1234–1249.
Neff, A., Kolk, A., 2023. Operative Therapie der Frakturen der Mandibula im Erwachsenenalter (ohne Gelenkfortsatz). Die MKG-Chirurgie 16 (3), 206–219.
Pabst, A., Thiem, D.G.E., Goetze, E., Bartella, A.K., Neuhaus, M.T., Hoffmann, J., Zeller, A.N., 2021. How is neck dissection performed in Oral and Maxillofacial Surgery? Results of a representative nationwide survey among university and non-university hospitals in Germany. Clin Oral Investig 25 (5), 3007–3019.
Pietzka, S., Kämmerer, P.W., Pietzka, S., Schramm, A., Lampl, L., Lefering, R., Bieler, D., Kulla, M., 2020. Maxillofacial injuries in severely injured patients after road traffic accidents-a retrospective evaluation of the TraumaRegister DGU® 1993-2014. Clin Oral Investig 24 (1), 503–513.
Raschke, G.F., Rieger, U.M., Bader, R.D., Schaefer, O., Guentsch, A., Schultze-Mosgau, S., 2013. Transconjunctival versus subciliary approach for orbital fracture repair–an anthropometric evaluation of 221 cases. Clin Oral Investig 17 (3), 933–942.
Reichert, C.S., Pienkohs, S.P., Skroch, L., Meisgeier, A., Neff, A., 2025. Risk factors and impact of intra-articular scarring after open reduction and internal fixation in mandibular condylar head fractures-A prospective analysis. J. Clin. Med. 14 (1).
Rivera Perla, K.M., Lopez, C.D., Zeyl, V.G., Lake, I.V., Girard, A.O., Puthumana, J.S., Redett, R.J., Lopez, J., Manson, P.N., Yang, R., 2022. Insurance status influences mandible fracture management and outcomes: a national inpatient sample analysis of 268 809 admissions. FACE 3 (4), 494–504.
Ronde, E.M., Nolte, J.W., Kruisinga, F.H., Maas, S.M., Lapid, O., Ebbens, F.A., Becking, A. G., Breugem, C.C., 2023. Evaluating international diagnostic, screening, and monitoring practices for craniofacial microsomia and microtia: a survey study. Cleft Palate Craniofac. J. 60 (9), 1118–1127.
Rößler, A., Freudlsperger, C., Engel, M., Ristow, O., Kühle, R., Hoffmann, J., 2023. Kiefergelenkfortsatzfrakturen – Indikationen und Kontraindikationen der konservativen Behandlung. Die MKG-Chirurgie 16 (3), 230–237.
Schneider, D., Kämmerer, P.W., Schön, G., Dinu, C., Radloff, S., Bschorer, R., 2015. Etiology and injury patterns of maxillofacial fractures from the years 2010 to 2013 in Mecklenburg-Western Pomerania, Germany: a retrospective study of 409 patients. J. Craniomaxillofac. Surg. 43 (10), 1948–1951.
Seifert, L.B., Mainka, T., Herrera-Vizcaino, C., Verboket, R., Sader, R., 2022. Orbital floor fractures: epidemiology and outcomes of 1594 reconstructions. Eur. J. Trauma Emerg. Surg. 48 (2), 1427–1436.
Shin, J.Y., Yoon, J.K., Shin, A.K., Diaz, A.Z., 2018. The influence of insurance status on treatment and outcomes in oral cavity cancer: an analysis on 46,373 patients. Int. J. Oral Maxillofac. Surg. 47 (10), 1250–1257.
Sinyuk, M., Polishchuk, V., Yuschak, P., Burachok, I., 2025. Management of war-related facial wounds in Ukraine: the Lviv military hospital experience. BMJ Military Health 171 (1), 12–15.
Skroch, L., Fischer, I., Meisgeier, A., Kozolka, F., Apitzsch, J., Neff, A., 2020. Condylar remodeling after osteosynthesis of fractures of the condylar head or close to the temporomandibular joint. J. Craniomaxillofac. Surg. 48 (4), 413–420.
Sun, H.B., Fallah, H., 2022. Efficacy and cost of maxillary patient-specific implants in orthognathic surgery: a review of three patient cases. Perm. J. 26 (1), 137–142.
Uems, O.E. T.F.o., 2024. European quality markers in oral and maxillofacial surgery specialty training: defining standards. Br. J. Oral Maxillofac. Surg. 62 (9), 769–779.
Wevers, M., Strabbing, E.M., Engin, O., Gardeniers, M., Koudstaal, M.J., 2022. CT parameters in pure orbital wall fractures and their relevance in the choice of treatment and patient outcome: a systematic review. Int. J. Oral Maxillofac. Surg. 51 (6), 782–789.
Yarter, J.T., Racht, J., Michels, K.S., 2023. Retrobulbar hemorrhage decompression with paracanthal "one-snip" method: time to retire lateral canthotomy? Am. J. Emerg. Med. 64, 206.e201–206.e203.
Zhang, Z.X., Xie, L., Li, Z., 2024. Global, regional, and national burdens of facial fractures: a systematic analysis of the global burden of Disease 2019. BMC Oral Health 24 (1), 282.
Zimmerer, R., Rana, M., Schumann, P., Gellrich, N.C., 2014a. Diagnosis and treatment of optic nerve trauma. Facial Plast. Surg. 30 (5), 518–527.
Zimmerer, R., Schattmann, K., Essig, H., Jehn, P., Metzger, M., Kokemüller, H., Gellrich, N.C., Tavassol, F., 2014b. Efficacy of transcutaneous transseptal orbital decompression in treating acute retrobulbar hemorrhage and a literature review. Craniomaxillofac Trauma Reconstr 7 (1), 17–26.
Zimmerer, R.M., Ellis 3rd, E., Aniceto, G.S., Schramm, A., Wagner, M.E., Grant, M.P., Cornelius, C.P., Strong, E.B., Rana, M., Chye, L.T., Calle, A.R., Wilde, F., Perez, D., Tavassol, F., Bittermann, G., Mahoney, N.R., Alamillos, M.R., Bašić, J., Dittmann, J., Rasse, M., Gellrich, N.C., 2016. A prospective multicenter study to compare the precision of posttraumatic internal orbital reconstruction with standard preformed and individualized orbital implants. J. Craniomaxillofac. Surg. 44 (9), 1485–1497.