

Comparing mixed reality with standard computed tomography (CT) images to teach students how to assess midface fractures

Submission date 20/10/2026	Recruitment status No longer recruiting	☐ Prospectively registered ☐ Protocol
Registration date 20/10/2026	Overall study status Completed	☐ Statistical analysis plan ☐ Results
Last Edited 20/10/2026	Condition category Other	☐ Individual participant data ☒ Record updated in last year

Plain English summary of protocol

Background and study aims

Doctors assessing fractures in the middle part of the face usually examine computed tomography (CT) images on a computer screen. Mixed-reality technology allows users to view and manipulate three-dimensional images through a headset. This study compared these two approaches in a learning exercise for medical and dental students. It investigated how useful and easy to use the students found each system, how closely their fracture assessments matched an expert reference, and how much time they needed.

Who can participate?

Medical and dental students in their third to sixth year of study who had no previous knowledge of or experience with the AO CMF midface fracture classification system were eligible.

What does the study involve?

Forty students took part and were randomly allocated to one of two groups. Twenty students used a Microsoft HoloLens 2 mixed-reality headset with Lumi software, while twenty examined conventional two-dimensional CT images on a hospital computer. After a short introduction and practice example, each student assessed four previously treated fracture cases and completed a questionnaire about the imaging system.

What are the possible benefits and risks of participating?

No medical treatment was given to participants, and patient care was not changed. The study offered no direct clinical benefit. Its findings may help educators evaluate the use of three-dimensional imaging technology in medical training. Some participants using a headset reported symptoms. Patient imaging was pseudonymised before use.

Where is the study run from?

Department of Cranio-Maxillo-Facial and Oral Surgery, University Hospital Zurich, Switzerland.

When is the study starting and how long is it expected to run for?

The participant assessment sessions were completed between 14 April and 16 May 2025. Each participant attended one session, with no subsequent follow-up assessment.

Who is funding the study?

The study used departmental resources at University Hospital Zurich. The headset equipment was already owned by the department, and the software licence was purchased by the institution. No specific external research grant was received.

Who is the main contact?

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Study information

Scientific Title

Head-mounted mixed reality versus two-dimensional CT review for structured midface fracture assessment by medical and dental students: an exploratory randomised trial

Study objectives

The study investigated whether head-mounted mixed-reality (MR) visualisation of CT data offers more favourable learner-reported usefulness, ease of use and satisfaction than conventional two-dimensional (2D) CT review during structured midface fracture assessment.

Secondary objectives were to compare agreement with a study-specific expert reference for AO CMF-derived fracture features and the time required to assess four midface fracture cases.

Ethics approval required

Ethics approval not required

Ethics approval(s)

Primary study design

Interventional

Allocation

Randomized controlled trial

Masking

Open (masking not used)

Control

Active

Assignment

Parallel

Purpose

Medical education and imaging-interface evaluation

Study type(s)

Health condition(s) or problem(s) studied

Medical education and image-based assessment of traumatic midface fractures using computed tomography.

Interventions

Forty medical and dental students were allocated in pairs to one of two study groups using a simple A/B draw. One participant in each pair was assigned to mixed reality (MR) and the other to conventional two-dimensional (2D) CT review, yielding 20 participants per group. Participants and investigators were not blinded.

In the MR group, participants examined pseudonymised CT-derived three-dimensional volume renderings using Lumi software on a Microsoft HoloLens 2 head-mounted display. The images could be manipulated interactively using hand gestures.

In the 2D group, participants reviewed CT images on a conventional hospital monitor using DeepUnity Review version 2.0.2.2, including axial, coronal and sagittal views with standard scrolling, zooming and windowing functions.

All participants received an approximately three-minute introduction to the allocated interface and completed a practice case that was excluded from the analysis. Each participant then assessed four distinct midface fracture cases randomly selected from a fixed pool of ten cases using Randomlist.org.

Participants recorded fracture features and review-and-classification time for each case and completed an adapted 15-item usability questionnaire after the four assessments.

Each participant attended one study session. No subsequent follow-up assessment was conducted. No clinical treatment was administered to study participants, and patient care was not affected.

Intervention Type

Device

Phase

Not Applicable

Drug/device/biological/vaccine name(s)

Microsoft HoloLens 2; Lumi mixed-reality imaging platform; DeepUnity Review version 2.0.2.2 (active comparator).

Primary outcome(s)

1. Perceived usefulness measured using four-item usefulness domain of an adapted 15-item Usefulness, Satisfaction, and Ease of Use (USE) questionnaire at immediately after completion of the four-case assessment
2. Perceived ease of use measured using four-item ease-of-use domain of an adapted 15-item Usefulness, Satisfaction, and Ease of Use (USE) questionnaire at immediately after completion of the four-case assessment
3. Satisfaction measured using five-item satisfaction domain of an adapted 15-item Usefulness, Satisfaction, and Ease of Use (USE) questionnaire at immediately after completion of the four-case assessment

Key secondary outcome(s)

1. Concordance of fracture assessments with expert reference assessments measured by comparison of participant assessments with a study-specific expert reference using features derived from the AO CMF classification system (anatomical side, target region, fragmentation, displacement status, and displacement direction) during the study session for each of four midface fracture cases
2. Review-and-classification time measured in seconds using a self-recorded smartphone stopwatch during the study session for each of four midface fracture cases

Completion date

16/05/2025

Eligibility

Key inclusion criteria

1. Medical or dental students enrolled in the third to sixth year of their respective degree programme
2. No self-reported previous knowledge of or experience with the AO CMF midface fracture classification system
3. Ability to attend a single study session and provide oral informed consent

Healthy volunteers allowed

Yes

Age group

Mixed

Lower age limit

18 Years

Upper age limit

99 Years

Sex

All

Total final enrolment

40

Key exclusion criteria

No additional exclusion criteria were specified beyond failure to meet the inclusion criteria

Date of first enrolment

14/04/2025

Date of final enrolment

16/05/2025

Locations

Countries of recruitment

Switzerland

Sponsor information

Organisation

University Hospital Zurich

ROR

<https://ror.org/01462r250>

Organisation

University of Zurich

ROR

<https://ror.org/02crff812>

Funder(s)

Funder type

Funder Name

Universitätsspital Zürich

Alternative Name(s)

University Hospital Zurich, USZ

Funding Body Type

Government organisation

Funding Body Subtype

Local government

Location

Germany

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary

Not expected to be made available