# Magnetic resonance imaging for jaw bone assessment: a systematic review

**Sofya Sadilina**[1,2], Hian Parize,[1,3] Marcel Hanisch,[1] Johannes Kleinheinz,[1] Dalva Cruz Laganá,[3] Newton Sesma,[3] Lauren Bohner[1]

[1]Department of Cranio-Maxillofacial Surgery, University Hospital Muenster, Muenster, Germany.
2Department of Oral and Maxillofacial Surgery, Pavlov University, Saint-Petersburg, Russia.
[3]Department of Prosthodontics, University of São Paulo; São Paulo, Brazil.

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## PECO QUESTION

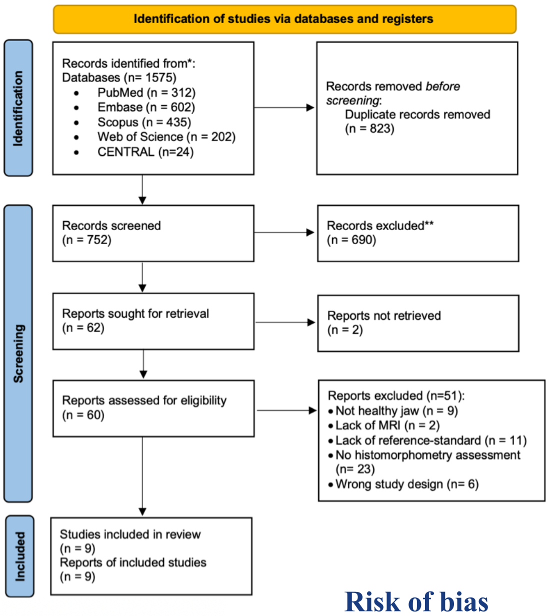
"What is the diagnostic accuracy of magnetic resonance imaging for maxillary bone assessment, compared to reference-standard measurements?

## METHODS

**(P) Population:** healthy maxilla and mandible sites.
**(E) Exposure:** magnetic resonance imaging (MRI).
**(C) Comparison:** reference-standard measurements (e.g. histology, physical measurements or computed tomography).
**(O) Outcome measures:** quantitative and/or qualitative bone histomorphometry measurements.
**(S) Studies:** diagnostic studies (e.g. experimental, observational, clinical, animal, in-vitro and ex-vivo design).

*A detailed protocol was registered on PROSPERO (*CRD42022342697*).*

PRISMA 2020 flow diagram for new systematic reviews.



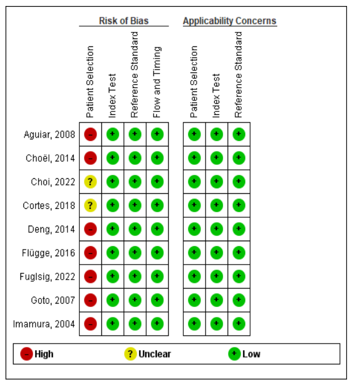

## RESULTS

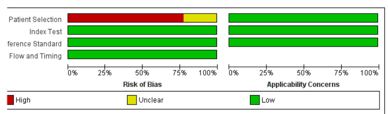
### Characteristics of included studies

| Author, year | Type of participants (N) | Evaluation site | Diagnostic purpose | Magnetic field and MRI device | MRI parameters | Reference test | No. of Examiners / experience | Evaluated outcomes | Summary of outcomes |
|---|---|---|---|---|---|---|---|---|---|
| **Aguiar, 2008** | Dry cadaver (5) | Anterior mandible | Linear measurement for dental implant planning | 1.0 T Signa Contour (GE HealthCare) | T2- weighted images, ST 2mm, table feed 1 mm, TR/TE 112/3.5 ms, FOV 26 cm, matrix 256x256 pixels, scanning time 3 min. | CT and digital caliper | 4 / specialists in radiology | Linear measurement (bone height) | There were no significant differences between the three tested groups (P=0.98). |
| **Choel, 2014** | Bone specimens (45) from fresh cadavers (15) | Anterior and posterior mandible | Trabecular bone assessment for determining optimal dental implant loading time | 2T Oxford 85/310 magnet (Oxford) with a SMIS console (MRS) | 2D spin-echo sequence, TE/TR 21/550 ms, FOV ~30x15 mm², ST 600 mm, matrix 256x128 pixels, in plane resolution > 110 mm, signal-to-noise ratio > 20, 40 averages, scanning time < 50 min. | DXA and bone densitometer | NR | DXA: bone mineral density; MRI: specific perimeter: ratio of bone perimeter and trabecular width. | Compared to female specimens, male specimens showed significantly higher values. The specimens from incisal regions showed the highest anisotropy. |
| **Choi, 2022** | Bone specimens (21) from patients (18) | NR | Evaluate bone marrow adipose tissue | 14 T Magnex interfaced to a Bruker BioSpin (Billerica, MA) | 3D gradient-echo sequence, TR/TE 48.6/2.6ms, matrix 256×256x256 pixels, scanning time ~14h. | CBCT and micro-CT | NR | MRI: BMAT content; Micro-CT: BV/TV; CBCT: radiodensity values. | The only statistically significant correlation (p 0.01) found was between micro-CT and 14 T MRI (r = 0.943). |
| **Cortes, 2018** | Bone specimens (7) from patients (7) | Mandible | BMF content assessment | 15 T 130-mm horizontal bore magnet (Agilent, Yarnton) | 3D gradient-echo pulse sequence, TE/TR 3.3/50 ms, receiver bandwidth 255-Hz, flip angle 25º, 16 averages, FOV 7.5×7.5×7.5 mm, matrix 128×128×128 pixels, voxel 59 m³, scanning time 32:07 min. | Micro-CT | 2 / MRI analysis: PhD in oral radiology. Micro-CT: PhD student. | MRI: BMF; Micro-CT and MRI: BV/TV | Fat tissue volume and BV/TV had a significantly strong inverse correlation. There was high level of agreement between BV/TV calculated from MRI and micro-CT. |
| **Deng, 2014** | Fresh cadaver (1) | Posterior mandible | Mandibular nerve visualization and linear measurement to cortical bone | 3 T Magnetom Trio (Siemens) | Fast gradient-echo sequence, TR/TE 2,3/3.67 ms, flip angle 10°, matrix 448x448 pixels, FOV 226x226 mm. | CT and digital caliper | NR | Linear measurement | No significant difference in average distance was reported between the three tested groups. |
| **Flügge, 2016** | Patients (2) and dry cadaver (1) | Posterior maxilla and mandible | Imaging exam for routine dental and maxillofacial diagnosis. | 3 T TIM Trio (Siemens) | Gradient-echo fast low flip angle shots. In vivo, mandible: Matrix 64× 64×28 mm, TE/TR 4.2/11 ms, flip angle 15°, three averages, scanning time 3:57 min. In vivo, maxilla: isotropic resolution 350 µm, FOV 34 cm³, TR/TE 12/4.8 ms, flip angle 15°, 5 averages, scaning time 6:40 min. | CBCT | 2 / dentist > 5 years dedicated to radiology | Linear measurement | Except for bone width measurements at 5mm, the majority of the bone measurement variations were statistically insignificant. The difference in mean measurements was not more than the method error. |
| **Fuglsig, 2022** | Cadaver specimens (12) | Posterior maxilla and mandible | Linear measurement (height and width) | 9.4 T Bruker Biospec (Bruker Biospin) | Zero-Echo-Time sequence, FOV 75 mm isotropic, matrix 3663 pixels, image resolution 0.205 mm, flip angle 0.74º, projection under sampling of two, 50 averages, scan time 6 h | CBCT and histology | 2 / dentist | Linear measurement | There was a significant agreement between CBCT, MRI, and specimens. MRI adequately exhibited hard and soft tissues |
| **Goto, 2007** | Patients (2), phantom (1), dry cadaver (1) | Anterior and posterior mandible | Linear measurement (distance between landmarks) | 1.5 T Symphony (Siemens) | 3D Vibe sequence. TR/TE 9.73/3.96 ms, flip angle 20º, voxel 0.7mm3, field of view 173x230mm, scanning time 6.5 min. | CT and micrometer | 2 / trained observers | Linear and angle measurement | The correlation coefficient between MRI and direct osteometry was strong. MRI accuracy was comparable to CT accuracy. |
| **Imamura, 2004** | Patients (11) | Posterior mandible | Linear measurement | 1.5 T (Shimadzu Corporation) | T1 weighted images, TR/TE 500/15 ms, FOV 150 to 260 mm, matrix 256x256, number of excitations twice, slice width 2.5 mm perpendicular to the dental arch and overlap 0.5 mm. | CT | 2 / 4 years prosthodontist 27 years prosthodontist | Linear measurement and nerve detection | The canal's dimensional location in the second molar area was nearly similar with MRI and CT. |

BV/TV, bone-volume-to-tissue-volume ratio; CBCT, cone beam computed tomography; CT, computed tomography; DXA, dual energy X-ray absorptiometry; FOV, field of view; NR, not reported; ST, slice thickness; T, Tesla; TE, echo time; TR, repetition time.

### Risk of bias




## REFERENCES

## CONCLUSIONS

Despite jaw bone assessment is feasible with MRI, further studies and advancements are required to improve the applicability and usefulness.

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