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Prevalence of mandibular asymmetry on panoramic radiography: A review study

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Abstract

Mandibular asymmetry shows up often during craniofacial evaluations. It can shift the way a person bites, talks, or appears. Sometimes it is subtle, more obvious. Detecting it early makes a real difference, especially when treatment planning is involved. In orthodontics and surgical contexts, missing it could mean missing the root of a bigger issue. Panoramic radiography (also called orthopantomogram or just OPG) gives a wide view of the jaws and surrounding areas. It shows vertical bone differences quite well. It reveals how one side of the mandible may not match the other. Over time, these small differences can matter, whether for braces, surgery, or understanding the facial structure as a whole.

Aim of the study: This review set out to explore how often mandibular asymmetry appears, specifically when evaluated through OPG.

Materials and methods: A selection of published studies was examined; all focused on detecting asymmetry through panoramic radiographs. The combined sample totaled 1,048 individuals, with study sizes ranging from 90 to 160 participants. Ages stretched from as young as 6 to as old as 70. The primary focus was on vertical height differences in the condyle and ramus, and how those measurements might line up-or not-with various skeletal malocclusion types.

Results: Across the examined literature, asymmetry prevalence drifted around 35 to 55%, with many individuals presenting clear variations when assessed using asymmetry indices. Findings leaned toward panoramic radiography (OPG) being fairly dependable for evaluating vertical mandibular discrepancies, though only under stable patient positioning and consistent imaging standards. Habets' approach came up frequently-often favored as a go-to for asymmetry measurement. Averaging out across sources, the recorded rate settled at about 42.7%. In terms of gender breakdown, prevalence appeared a touch higher among females at 41.1%, compared to 35.2% in males. Though statistical tests didn't bring out any meaningful gap between the male and female groups overall (P above 0.05), a closer look at the female data did uncover clear differences between right and left sides. The contrasts were most evident in condylar height and mandibular measurements, where P values landed at 0.01 and 0.02. These kinds of asymmetrical patterns didn't come through in the male subgroup, where the side-to-side variation stayed more subdued. When comparing ramus height asymmetry, men showed a modestly larger difference on average, landing around 1.12 mm, whereas women measured close to 1.02 mm. Also worth noting, skeletal Class III cases stood out, often linked with more pronounced asymmetry-left side more frequently involved.

Conclusion: Reported prevalence for mandibular asymmetry on panoramic radiographs shifts widely. In some populations, figures dip close to 35%. In others, they stretch past 50. This review found it settles near 42.7% overall.

Keywords: Mandibular asymmetry; Mandible; Facial asymmetry; Panoramic radiography; OPG.

Introduction

Symmetry, or sometimes just the sense of proportion, generally points to how much facial features mirror one another in shape, placement, and size across that vertical midline of the face. Facial structure in humans carries weight, especially in social settings where first impressions matter. A face that looks even or well-balanced often has more pull when it comes to perceived attractiveness and appeal. But flawless symmetry, as it's often imagined, doesn't really happen. Quite a few faces that seem symmetric at a glance actually show some level of craniofacial imbalance once cephalometric images are reviewed [1]. Growth of the skull, along with the upper jaw and lower jaw, tends to follow a connected path. Still, when growth goes off track in one of these regions, that mismatch can set off a pattern of uneven development-leading sometimes to a chin that shifts away from where it should be. Those with this kind of chin deviation tend to show other asymmetries elsewhere in the facial structure. Some causes are rooted in genes, others in injury. These imbalances can involve muscles or even lead to extra growth on one side, sometimes disrupting how the mandible forms over time [2]. Among the more visible signs linked to mandibular asymmetry are a slight chin deviation leaning toward the shorter side and a more pronounced gonial angle along the extended portion of the jaw. On the dental side of things, patterns may emerge like an open bite developing on the longer half, midline drift moving away from that same side, crossbite appearing on the shorter section, and a somewhat slanted frontal occlusal plane. A handful of clear contributing factors often surface, including prior traumatic injuries involving fractures, neoplastic growths, or developmental irregularities present from birth [3]. This form of asymmetry belongs to a broader category of facial conditions that interfere with harmony and proportionality across the face. More marked forms of the issue tend to come with noticeable cosmetic and practical effects, which sometimes spill into emotional or social aspects of daily living [4-6]. When it comes to how often this condition shows up, the numbers found across studies do not stay within a narrow window. Some papers mention it in as little as 17% of cases while others note it closer to 73%. These figures change based on who was included in the research, how the data was gathered, and what definitions were used. Among the groups examined, individuals with skeletal Class III patterns tended to show this kind of asymmetry more than others. In those cases, the reported rates went from about 23% up toward 78% [7]. Causes behind asymmetry in the mandibular area tend to come from different directions. Trauma during growth, for example, often leaves lasting irregularities. Some cases link back to developmental anomalies, which may shift normal bone contour. Muscular disturbances-torticollis being a frequent one can also disrupt balance over time. Some conditions, like Treacher Collins, show up with clear changes in facial structure. Occlusion that comes in contact early may shift the jaw bit by bit, leaving it off-center. Over time, disorders in the joint rheumatoid arthritis for instance, start to wear things down. Swelling builds. Erosion sets in. Eventually, symmetry gives way [8,9]. Used often in routine dental practice, the panoramic radiograph brings a fair balance between cost and clinical value, mostly because radiation exposure stays at a low level [10]. What makes it helpful is the way it captures both sides of the jaws in one frame, giving a decent look at vertical dimensions. Still, not every aspect comes out clearly. Research suggests horizontal readings tend to fall short, mainly because magnification shifts unpredictably with depth in the image field [10]. On the other hand, if the head stays aligned just right in the machine, vertical and angular figures usually hold up well enough for evaluation [11].

Materials and methods

This review was conducted to evaluate and synthesize existing literature on the use of panoramic radiography (orthopantomogram, OPG) in the assessment of mandibular asymmetry. The review encompassed a wide demographic scope, including age groups between 6-70 years, reflecting the relevance of mandibular asymmetry assessment across different life stages. The reviewed articles were published in peer-reviewed journals, including case reports, original research, and review-based studies. A structured and focused literature selection process was followed to ensure comprehensive and balanced inclusion of studies addressing the topic. Information was extracted independently from each article, and only data directly related to the OPG analysis of mandibular asymmetry were retained for synthesis.

Results

Several published papers were brought together to better understand how often mandibular asymmetry appears and how severe it tends to be when viewed through panoramic radiographs, commonly referred to as OPG. The total sample, when combined, reached one thousand and forty-eight individuals. The number of participants in each study wasn't the same. Some included around ninety subjects, others stretched closer to one hundred sixty. These groups involved a mix of ages, mostly from adolescent to adult categories. The scope wasn't always identical, but the general aim across all sources remained focused on describing the visible asymmetry through imaging. The rates of asymmetry detection weren't uniform-far from it. Reports showed a wide spread, hovering between 35% and 55%, depending heavily on where and how each study was carried out, and on the characteristics of the people being studied. From that data pool, the average prevalence settled around 42.7%, placing asymmetry as a fairly frequent observation

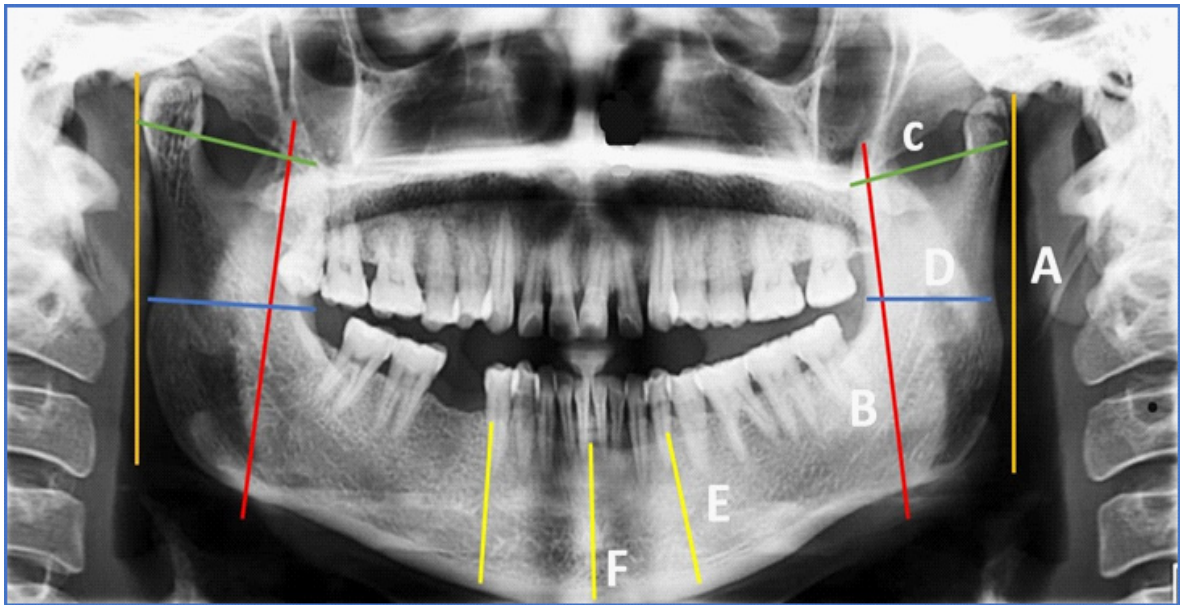

Figure 1: An example of panoramic radiograph simulating the linear measurements for mandibular asymmetry: **(A)** Ramus height, **(B)** Coronoid height, **(C)** Maximum ramus width, **(D)** Minimum ramus width, **(E)** Symphysis height, **(F)** Mandibular corpus height.

in clinical samples. When sorted by sex, 35.2% were found in males and 41.1% in females. The female percentage came out higher, but numbers alone didn't support a meaningful difference-statistical testing placed it above the accepted threshold (P greater than 0.05). Yet, digging deeper into female-specific results showed something noteworthy. Clear disparities were seen between the two sides of the mandible. These side-to-side gaps were statistically significant in terms of both mandibular and condylar height, with P-values clocking in at 0.02 and 0.01, respectively, suggesting a paired t-test was likely applied for side comparisons in females. For males, those lateral imbalances weren't as marked. The gap in ramus height came in at about 1.12 millimeters with a deviation of plus or minus 0.64, while in females it was a bit lower at 1.02±0.65 mm [3]. Not a huge contrast, but enough to note. Interestingly, patterns repeated across multiple reports pointed to a recurring trait in individuals with skeletal Class III profiles. Left-side dominance in asymmetry appeared again and again in that group, hinting at a trend worth paying attention to. In the end, why such variation exists between studies likely ties back to multiple layers-differences in age demographics, measurement strategies, radiographic techniques, and even regional anatomical trends. Because of this, while panoramic radiographs continue to offer strong practical value for identifying mandibular asymmetry, any interpretation of prevalence needs to stay anchored in the specific conditions under which the data were collected (Figure 1).

Discussion

The current overview brought together evidence from nine separate studies published between 2019 and 2024, examining a collective pool of more than 1,000 subjects assessed for mandibular asymmetry through panoramic imaging. Findings gathered from this group reflect how OPG continues to hold a practical role in observing vertical irregularities, especially those found within condylar and ramal dimensions. Asymmetry rates didn't hold steady; they moved across a spectrum—somewhere around 35% on the low end and reaching close to 55% on the higher side. Averaged out, the overall prevalence across examined literature seemed to hover near 42.7%. Interestingly, side-based differences in vertical measures—specifically in condylar and mandibular heights-came out significant, but only in female subjects. Males showed a marginally greater average difference in ramus height, about 1.12 mm, with females slightly trailing at 1.02 mm. Panoramic radiographs continue to be the go-to in many clinical environments, largely due to how readily available they are. These radiographic films help in observing each side of the mandible, offering a way to make comparisons. From this, vertical measurements can be taken, and symmetry may be roughly estimated [12]. Tonje and others once worked through calculations. Their goal was to understand how precise these measurements from panoramic views might be. What they found was conditional. When the head is well aligned, vertical dimensions tend to be somewhat trustworthy. Still, the same cannot be said for the horizontal plane. That part came across as far less consistent, with frequent errors in scale or shape [13]. In a different setting, Habets and the team shifted a model mandible. They moved it gradually off-center, reaching about ten millimeters away from midline. A Siemens orthopantomography 5 was used for this task. Nine radiographs were taken in total. From these, they noted that differences around 6% in condylar height could just be mechanical, maybe something technical. But when the gap went beyond that number, it seemed more likely the variation had anatomical meaning. That is, not just noise or distortion from the machine [14]. Other study tried to see how well lateral cephalograms and OPGs agreed, especially with those measurements orthodontists and maxillofacial surgeons often use. They applied something called the intraclass correlation coefficient, ICC, to check for consistency in the numbers. What they found-nothing major stood out. The measurements didn't drift much between the OPG and the lateral cephalometric view. Just about the same, really [15,16]. In earlier work, Kjellberg et al. Examined two dry skulls imaged across six positions using three separate panoramic systems [17]. Findings suggested that the magnification stated by manufacturers might not accurately reflect what appears in every region of a panoramic image. Each panoramic unit produced slightly different outputs. To minimize influence from positional and optical distortions, the condylar ratio was proposed as a more stable method to observe height discrepancies between condyles. In a related effort, Laster and

colleagues studied horizontal and vertical landmarks on 30 human skulls. Accuracy levels for asymmetry detection varied: ideal positioning reached 67%, rotational variation slightly improved results at 70%, but shifting lowered accuracy to 47%. Their conclusion leaned toward caution when relying on absolute values or attempting comparisons across cases without accounting for these inconsistencies [18]. Some findings pointed again and again toward the left side. A lean in the ramus. A drop in condylar height. Noticed. Measured. Repeated [1]. Earlier works with cephalometric films, others using CBCT, followed the same line. A similar tilt. A shift in symmetry [2]. Possible reasons float between chewing habits, side-dominant mastication, or maybe slight imbalances that develop slowly over time. No full agreement in the literature. Some see it as structure. Others call it noise. Anatomy tells a story, but the ending stays uncertain. Some propose functional significance while others see it more as part of the natural variety in human structure [3]. Clinically speaking, such patterns give more weight to the role of OPG in both orthodontic planning and surgical mapping. When consistent evaluation methods come into play, like the Habets approach used for measuring condylar and ramal heights, panoramic films become quite telling [4]. They help paint a clearer picture of jaw symmetry and overall facial proportion. Add to that the fact that panoramic imaging doesn't demand much from the patient or the clinic in terms of invasiveness or cost, and its position as an early diagnostic step makes even more sense [5]. Some issues did come up in the review. The way different studies handled their methods felt uneven. One had a large group; another did not. Some used certain asymmetry limits, others used different ones. The tools and ways to measure were not always shared across the board [1]. Only using flat images may skip over details that sit across the width of the jaw. Certain turns or slight shifts in bone may pass unnoticed. These might only appear with deeper scans. Three-dimensional imaging, like CBCT, tends to bring those details into clearer view [2]. Refining artificial intelligence criteria to account for differences in age ranges or skeletal classifications seems like a logical step forward [3]. Matching what shows up in 2D scans with what truly exists in 3D space might help ground the findings further, especially if tested across broader, more diverse clinical centers [4]. Even with its flaws, the collected data doesn't waver in its message: panoramic imaging keeps proving useful when it comes to flagging mandibular asymmetry. It's a tool that, for now, still holds value—both in classrooms and clinics alike [5].

Conclusion

Rates of mandibular asymmetry on panoramic films shift from one group to another. Some fall near 35%, others rise above 50. This review settled the average around 42.7. Image quality may not go deep, but still works well in early checks. Vertical shifts show up clearly. Repeat use brings steady results. New methods, like digital overlays or even machine help, may push its role forward again.

Variability appears tied to sample traits, diagnostic technique, and even how asymmetry is defined. The panoramic image, despite its limits, holds practical value. Especially when vertical differences come into focus. Reproducibility has been noted. So has clinical usefulness. Compared to more advanced imaging, it lacks depth. Yet it continues to serve early-stage evaluations quite well. Particularly when routine protocols shape its use. Some researchers now point to digital overlays, perhaps machine-guided annotation, as ways to sharpen its performance. A role that once seemed static may be shifting again.

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