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The mandibular lingual foramen: a consistent arterial foramen in the middle of the mandible

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ABSTRACT

The lingual foramen in the midline of the mandible causes confusion in terminology, incidence of occurrence and contents. A survey of 314 dried mandibles showed the foramen to be present in 311 specimens (99.04%). Sectioning of cadaver specimens illustrated a canal traversing the bone to approximately 50% of the buccolingual dimension of the mandible. The contents of the foramen were found to be an artery, which was an anastomosis of the sublingual branches of the right and left lingual arteries. Wire markers were placed in the foramen and the genial tubercles were covered with lead foil to illustrate the radiographic relationship between them. The radio-opacity peripheral to the foramen as seen on a radiograph is produced by the wall of the canal and not the genial tubercles as previously reported. While the foramen is not seen on many radiographs of the lower incisor region, this can be accounted for by a change in orientation of the x-ray beam. A pilot study revealed an incidence of 49% of the lingual foramen on periapical radiographs of the mandibular incisor region in an adult population, the previous reported incidence being 28%.

Keywords: Lingual artery; genial tubercles.

INTRODUCTION

There are many unnamed accessory foramina present in the mandible, especially on the lingual side. They are very variable in their distribution and may be of significance in relation to the effectiveness of local anaesthetic solutions administered for dental procedures (Sutton, 1974). The lingual foramen is situated in the midline, level with or superior to the genial tubercles (Fig. 1). Shiller & Wiswell (1954) found a median lingual foramen in 88.9% in 126 specimens, while in Sutton's survey (1974) of 300 mandibles, the foramen was present in 85% of mandibles examined.

When seen on intraoral radiographs of the mandibular incisor region, the foramen appears as a circular area of radiolucency surrounded by a peripheral radio-opacity (Fig. 2). The radio-opacity which surrounds the foramen has been reported to be the genial tubercles (Worth, 1963; Ennis et al. 1967; Bhaskar, 1970; Frommer, 1981; Gibilisco, 1985; Thunty, 1988; Kasle, 1989; Langlais & Kasle, 1992). Goaz & White (1987) and Seward (1963) stated that the radio-opacity is not produced by the genial tubercles but is the cortical wall of the canal leading to the foramen. Barr & Stephens (1980) warned against confusing the radio-opacity with the genial tubercles.

In a review of some general anatomy textbooks (Last, 1984; McMinn & Hutchins, 1988; Woodburne & Burkel, 1988; Williams et al. 1989; Agur, 1991; Moore, 1992), a consistent mandibular lingual foramen is not described. Dental anatomy texts (Berkovitz et al. 1977; Liebgott, 1982; Longham & McRae, 1985) equally failed to note the presence of the foramen as a consistent finding. The foramen is well identified in textbooks relating to radiographic dental anatomy, but there is some difference in terminology used. Goaz & White (1989), Kasle (1989) and Manson-Hing (1990) referred to the foramen as the lingual foramen. Ingram (1950) described a central pit, Poyton & Pharoah (1989) referred to the midline pit, whereas Worth (1963) referred to an unnamed foramen.

The contents of the foramen have equally caused confusion. Ennis (1937) described the contents as an artery, being a branch of the incisive artery that

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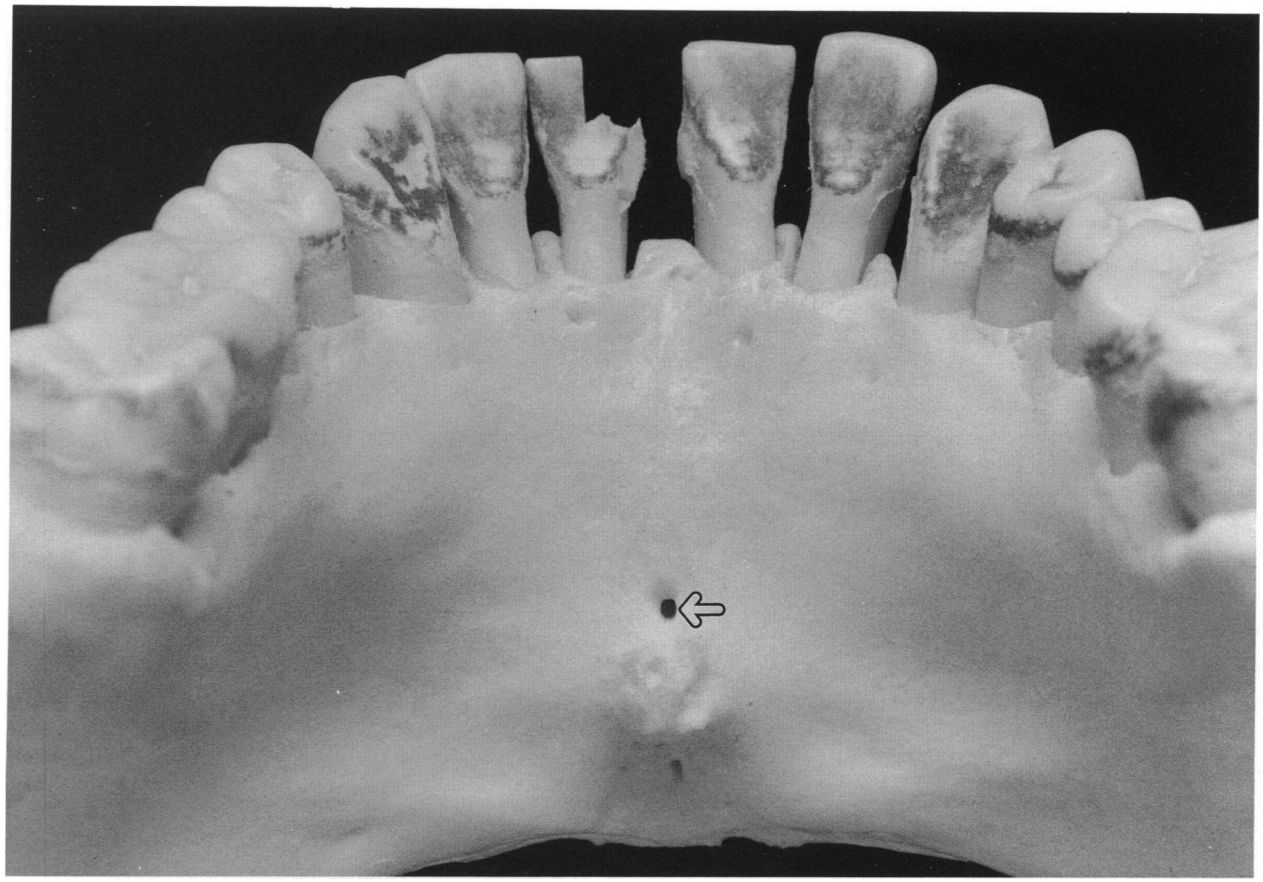

Fig. 1. The lingual side of the symphysis of the mandible showing the lingual foramen (arrow), in the midline, above the genial tubercles.

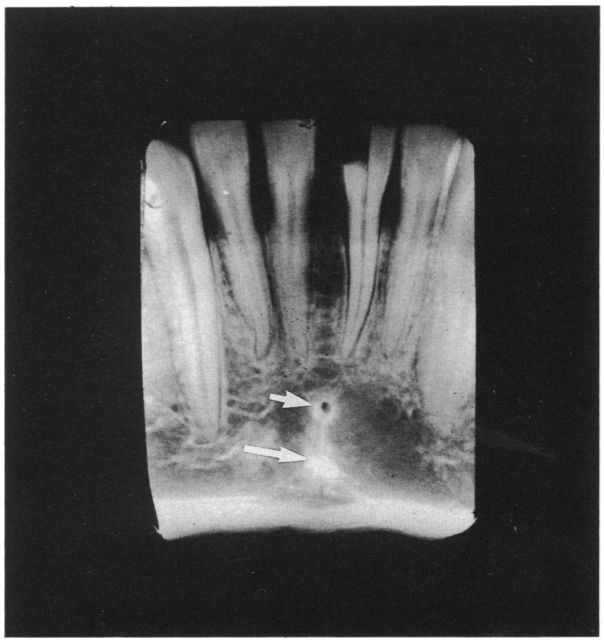

Fig. 2. A periapical radiograph of mandibular incisor teeth showing the midline radiolucency of the foramen with the peripheral radio-opacity (short arrow) of the wall of the canal, above the genial tubercles (long arrow).

anastomosis with the lingual artery. Sutton (1974) described the structures associated with the foramen as a neurovascular bundle. Goaz & White (1987) described the foramen and canal as being the termination of the incisive branch of the mandibular canal. As the mandibular canal contains a neurovascular bundle, this implies that the contents of the foramen would be a neurovascular bundle.

The incidence of the foramen radiographically has been reported by Sweet (1942) at 28% of 500 radiographs of the mandibular incisor region, while Poyton & Pharoah (1989) reported that the foramen is seen in only a small percentage of radiographs of the incisor region. This would seem to differ from the reported incidence of the foramen as quoted by Shiller & Wiswell (1954) and by Sutton (1974).

In view of the difference of opinion and lack of consistency associated with this foramen, this study was designed (1) to document the presence of the foramen in a dried skull survey; (2) to determine the contents of the foramen by dissection and histological assessment; (3) to demonstrate the relationship of the genial tubercles to the foramen as seen radio-

graphically, and (4) to record the incidence of the foramen on radiographs of the lower incisor region.

MATERIALS AND METHODS

Dried mandible survey

Dried mandibles (314 specimens) were examined for the presence of a foramen in the midline on the lingual side of the mandible at or above the genial tubercles. The majority of the mandibles originated in eastern India, with a small number of Australian Aboriginal origin. The foramen was considered present if it was single, positioned in the midline and level with or superior to the genial tubercles. Many other foramina were noted on the lingual side of the mandible in the incisor region and no attempt was made to document these.

Dissection

The symphysis area of 28 mandibles was dissected to determine structures associated with the foramen. In 12 of the 28 specimens, the soft tissue entering the foramen was removed and prepared for histological examination and staining using standard techniques. Ten specimens were sectioned transversely and 2 longitudinally. Four intact mandibles, with the soft tissues of the neck and floor of mouth attached, were then dissected, using blunt and fine dissection, to determine the continuity of vessels associated with the lingual foramen.

Radiographs

A thin metal wire was placed in the lingual foramen to aid in beam orientation along the long axis of the canal. Lead foil was used to cover the genial tubercles and a radiograph was exposed with the foil in place, using the same beam orientation as with the wire.

Radiograph survey

Periapical radiographs of the mandibular incisor region of 100 adult dentate patients were reviewed to assess for the presence of the lingual foramen. The criteria for inclusion in the survey was a periapical radiograph of the mandibular incisor region, with the beam of radiation centred in the midline, as judged by visualisation of the teeth. All the radiographs had been exposed using standard exposure factors utilising the paralleling technique and a film holding device. The foramen was considered present if there was a circular area of radiolucency with a peripheral radio-opaque rim in the midline, below and not related to the apices of the central incisor teeth. A typical example is illustrated in Figure 2.

RESULTS

A lingual foramen, as illustrated in Figure 1, was found to be present in 311 of 314 dry specimens (99.04%), the foramen being absent in only 3 specimens (0.96%). Dissection of the 28 wet specimens showed that only a single vessel entered the foramen. Figure 3 illustrates a midsagittal view of 1 of the specimens through the foramen. Figure 4 illustrates a typical cross-sectional view of the soft tissue associated with the foramen. The single vessel that entered the foramen was an anastomosis of vessels from each side. The 4 mandibles with neck attached all had the right and left sublingual arteries traced to confirm that they joined to form a common single vessel, as shown in Figure 5. Consistently, the

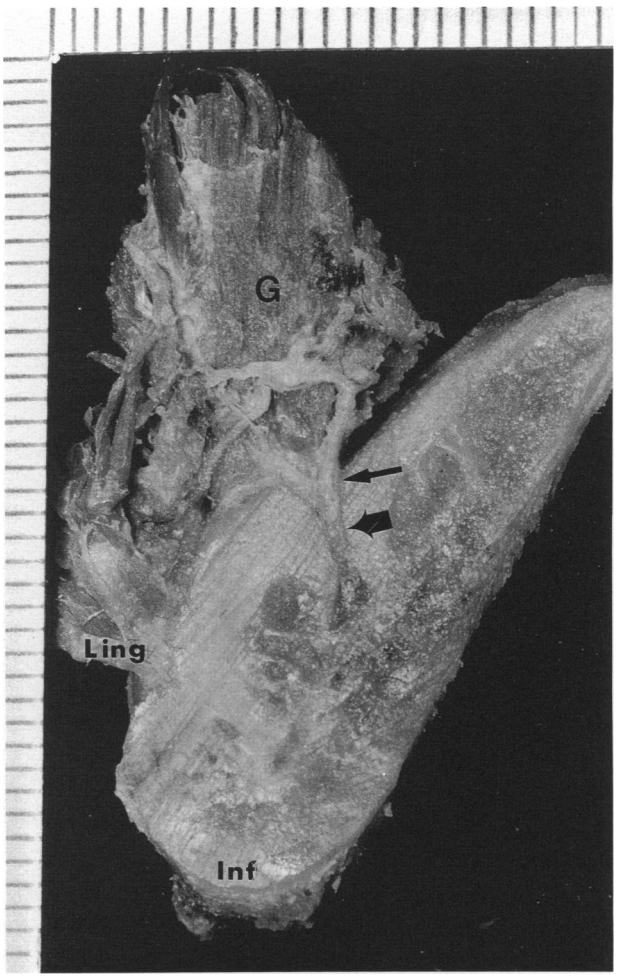

Fig. 3. Midsagittal view of the symphysis of the mandible from the right side showing the artery (arrow) entering the foramen and the canal (heavy arrow) leading to/from the foramen. G, genioglossus muscle; Inf, inferior; Ling, lingual.

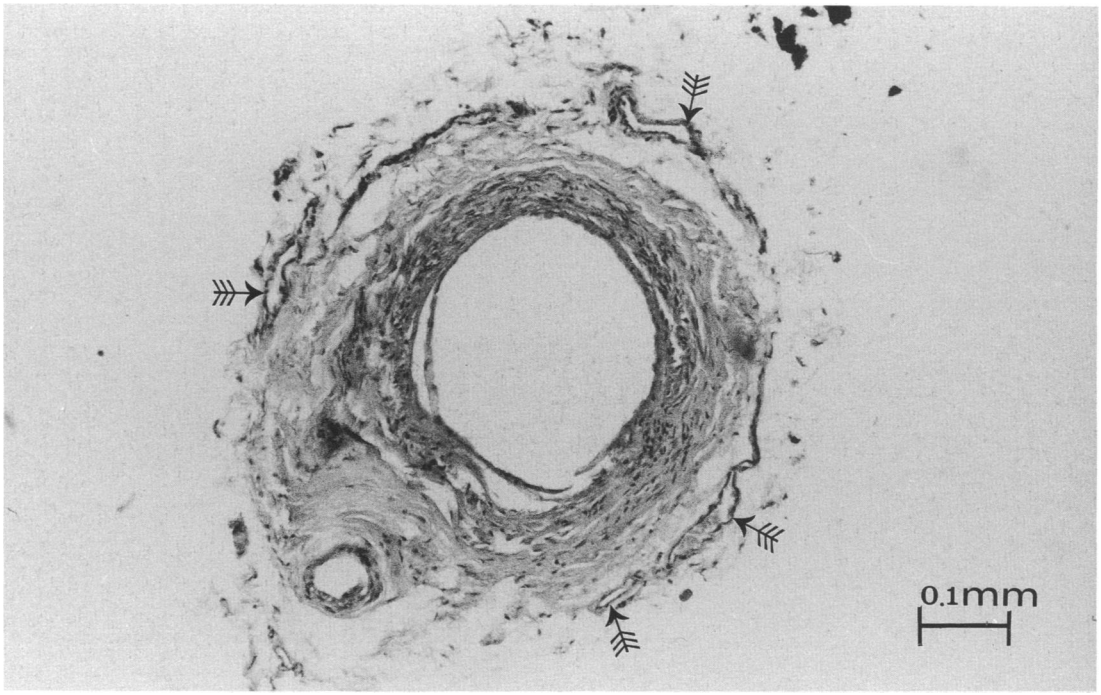

Fig. 4. Cross-sectional photomicrograph of the soft tissue entering the foramen, stained with haematoxylin and eosin, showing an artery and a plexus of perivascular veins (arrows).

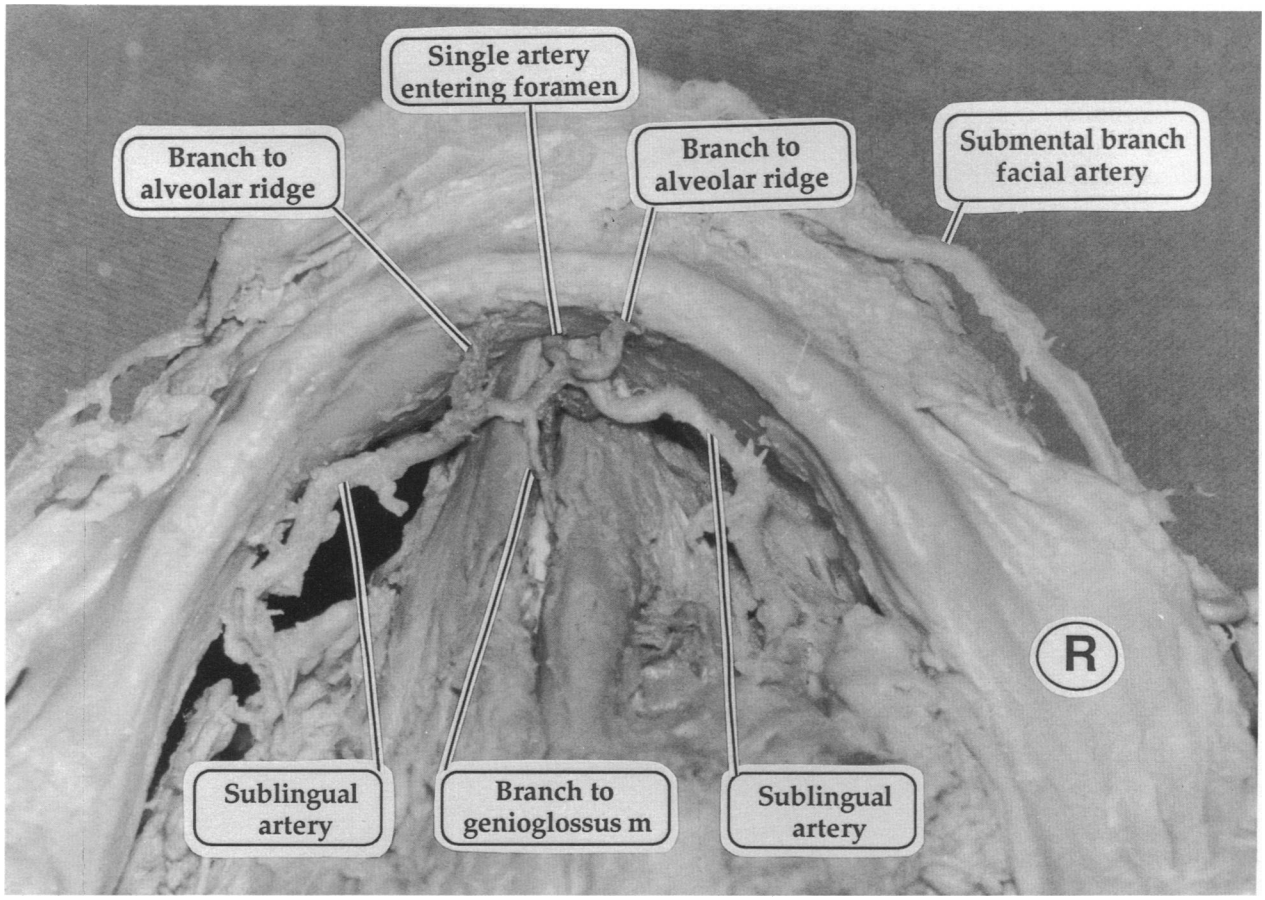

Fig. 5. Dissection of the floor of mouth, viewed from the superior aspect, illustrating an anastomosis of the right and left sublingual branches of the lingual arteries to form a single vessel entering the foramen. R, right side.

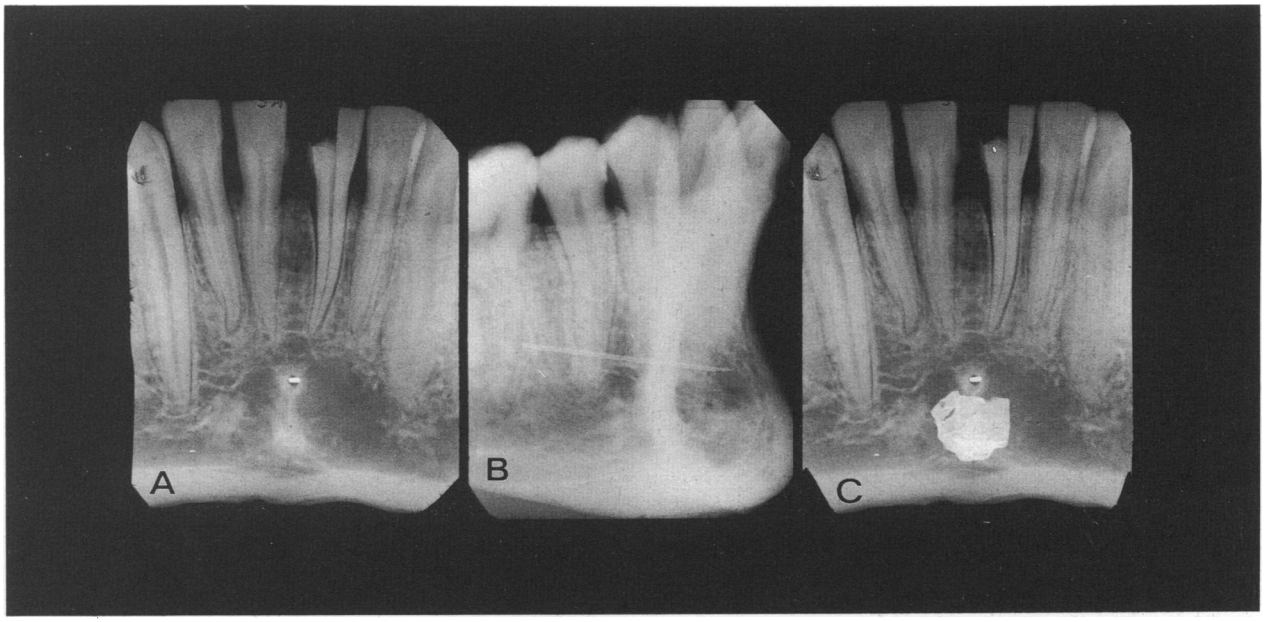

Fig. 6. Three radiographs of the symphysis of the mandible. (*A*) shows a wire in the foramen with peripheral radio-opacity, (*B*) is a lateral view to illustrate the depth of the wire in the mandible and in (*C*) lead foil covers the genial tubercles.

Fig. 7. Two radiographs of the lower incisor region of the same mandible shown in Figures 2 and 6, illustrating how a change in X-ray beam angulation results in loss of radiographic visualisation of the foramen.

anastomosed vessel entered the lingual foramen, 2 small vessels, branches of the sublingual arteries, entered foramina on the lingual cortical plate in the lateral incisor region, close to the crest of the alveolar ridge and there was a single branch supplying the superior surface of the genioglossus muscle.

Cross-sectional histology of the 10 specimens confirmed the vessel to be an artery, with a typical example illustrated in Figure 4. There was a plexus of perivascular vessels and occasional very small nerves around the artery. There was no evidence of a neurovascular bundle or of a vein of compatible size to the artery present. The 2 longitudinal sections showed a single artery.

Figure 6*A* demonstrates that the radio-opacity around the foramen, with a wire marker in position, is produced by the wall of the canal when the beam of radiation is parallel to the canal. The radio-opacity of

the genial tubercles is well outlined below the foramen. The course of the canal from the lingual side, as outlined by the wire shown in Figure 5*B*, shows the depth of the canal into the mandible, and is compatible with the midsagittal view of the wet specimen shown in Figure 3. When the genial tubercles were covered by lead foil, they were clearly separated radiographically from the foramen and peripheral radio-opacity as seen in Figure 6*C*. When this same specimen had the orientation of the x-ray beam changed in a vertical or horizontal direction, the radiographic evidence of the foramen was no longer present (Fig. 7).

The survey of 100 adult patients showed radiographic evidence of the lingual foramen in 49%, with no evidence of the foramen in 51% of the radiographs examined. A typical example of the foramen is shown in Figure 2.

DISCUSSION

This study would suggest that the lingual foramen is a consistent finding on the lingual side of the mandible in the midline, being present in over 99% of the dried specimens examined. This is a higher incidence than that previously reported by Shiller & Wiswell (1954) and Sutton (1974), who reported 88.9% and 85% respectively.

An anastomosing single branch from the lingual arteries, without an accompanying vein, entered the foramen. Ennis (1937) described a terminal branch of the inferior alveolar artery as passing through the lingual foramen to anastomose with the lingual artery. In view of the size of the artery associated with the foramen, it is more logical to assume a lingual origin rather than a derivation from a terminal branch of the inferior alveolar artery. Sutton (1974) and Goaz & White (1987) described the contents as a neurovascular bundle, which description implies a nerve, artery and vein. Although minute nerves were observed in histological sections, no nerves were identified with fine dissection. The size of the nerves is more compatible with an arterial vasomotor supply (Todd, 1980; Todd & Tokita, 1981). Anastomosis of blood vessels is a common occurrence, for example around joints, and the arterial circle of Willis is a good example in the head and neck. An anastomosis to form a single midline vessel is unusual.

In this study, the peripheral circular radio-opacity has been shown to be produced by the wall of the canal, when the beam is parallel to the canal. This is in agreement with Goaz & White (1987), but differs from that reported by Worth (1963), Ennis et al. (1967), Bhaskar (1970), Frommer (1981), Gibilisco (1985), Thunty (1988), Kasle (1989) and Langlais & Kasle (1992). Radiographic evidence of the foramen disappears when the beam orientation changes in either a vertical or horizontal orientation, as illustrated in Figure 7.

The survey of radiographs from 100 patients to document the presence of the foramen radiographically revealed an incidence of 49%. This is much lower than the actual incidence of the foramen, which is in agreement with other reports. The 49% incidence is much higher than the 28% reported by Sweet (1942) and the small percentage suggested by Poyton & Pharoah (1989). As shown in Figure 7, this can be accounted for by a change in x-ray beam orientation in the horizontal or vertical plane.

The number of dry specimens in this study is compatible with previous reported studies. The number of wet specimens is limited at 32 in total. While the number is small, there is consistency in that only an artery entered the lingual foramen, confirmed by histology in 12 cases. In the mandibles with neck attached, there was an anastomosis of the sublingual arteries to form a single vessel which entered the foramen. The midsagittal view of the mandible in Figure 3 shows the canal to extend to at least 50% of the buccolingual dimension of the mandible. This relates well with the radiographic evidence when a wire is placed in the canal (Fig 6*B*).

The artery is of sufficient size to present difficulty in control of haemorrhage intraosseously or in soft tissue and, in view of its position, could be a factor in implant placement in the midline. The foramen is large enough to be used as a route of administration by infiltration of local anaesthetic solution to the mandibular incisor region.

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