J. Anat. (1971), **108**, 3, pp. 433–440
With 8 figures
Printed in Great Britain

The intramandibular course of the inferior alveolar nerve

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(*Received* 15 *June* 1970)

Few accounts of systematic dissections of the inferior alveolar nerve have been published since Olivier's study (1927) of 50 mandibles. He found that in 30 of these the mandibular canal contained the whole of the inferior alveolar neurovascular bundle, while in the remaining 20 the vessels and branches of this bundle were spread out so that a distinct canal was not present.

Starkie & Stewart (1931) described five dissections, in each of which the main nerve divided into (1) an alveolar branch, responsible for the formation of an alveolar plexus supplying the molar and premolar teeth and possibly the canines, and (2) a branch passing forwards to supply the mental region and the incisor teeth. They also stated that in the posterior two-thirds of their intramandibular course the inferior alveolar nerve and vessels were surrounded by a sheath of compact bone, and a tough thick layer of connective tissue. Starkie & Stewart referred briefly to the work of Olivier (1927), only to contradict his findings.

We therefore determined to dissect, in detail, the inferior alveolar nerve in the ramus and posterior part of the body of the mandible, in order to resolve the discrepancies between the previously published accounts.

MATERIALS AND OBSERVATIONS

Dissection

Eight mandibles, with muscles of mastication still attached, were dissected. The attachments of the muscles were closely inspected and in several instances neurovascular bundles were seen leaving the muscle and penetrating the surface of the mandible. Next the compact bone on the lateral surface of the ramus and body of the mandible was removed by the use of dental burr, hammer and chisel. This exposed cancellous bone, in the spaces of which were fat and marrow which were picked or washed out. By this method a fine network of neurovascular bundles could be exposed in the area lateral to the roots of the molar teeth and extending up into the ramus (Fig. 1). With care, elements of the network could always be traced backwards or upwards to one or more foramina in the areas of insertion of the muscles of mastication. The most common connexion was with bundles leaving the lateral pterygoid and temporal muscles. The neurovascular bundles leaving the temporalis were traced to foramina in the retromolar fossa, where the lowest fibres of the temporalis gain their insertion. This part of the network ramified through the cancellous bone, and eventually established one or more obvious junctions with the main trunk of the inferior alveolar nerve, or with branches sent by the latter

to the molar roots. Several of the bundles of this posterior plexus were examined microscopically, and nerve fibres and blood vessels were consistently demonstrated.

In three of the eight dissections direct communications between the nerves entering the mandible at the retromolar fossa and the branches entering the roots of the 3rd or 1st molar teeth were clearly demonstrable. The nerves concerned lay in separate bony channels which required delicate dissection.

After exposure and examination of the neurovascular network the dissection was carried further to demonstrate the arrangement of the inferior alveolar nerve itself. The main trunk of the nerve approached the lateral aspect of the roots of the posterior molars, and the branches of supply to those roots usually entered the lateral surfaces of the roots near their apices, rather than through the apices themselves. The pattern of distribution of the inferior alveolar nerve was classified into three types.

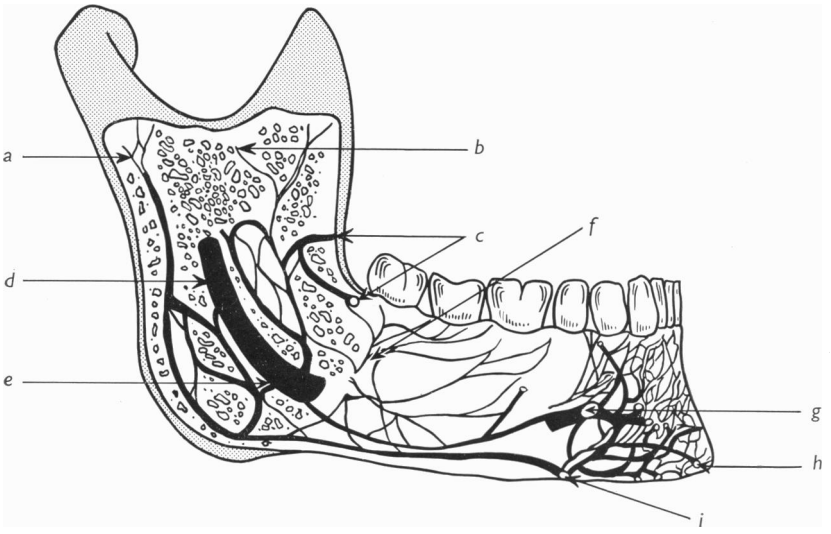

Fig. 1. Superficial neurovascular plexus exposed on dissection of the mandible from the lateral side.

KEY TO FIGS. 1–4

(*a*) Neurovascular communications between the plexus in the ramus and the insertion of the lateral pterygoid muscle, passing through foramina in the neck of the mandible.

(*b*) Similar communicating branches linking the plexus in the ramus with the insertion of the temporalis on the coronoid process.

(*c*) Larger communicating branches, passing through foramina in the retromolar fossa and linking with the lower part of the insertion of the temporalis.

(*d*) Lateral surface of the inferior alveolar neurovascular bundle.

(*e*) Link between the superficial neurovascular plexus and the inferior alveolar nerve.

(*f*) Superficial plexus in the body of the mandible, with branches to the gums.

(*g*) Mental nerve, cut off at the mental foramen.

(*h*) Neurovascular communicating branches passing through foramina near the mental spines.

(*i*) Similar branches communicating with the mylohyoid nerve through foramina on the inner aspect of the body of the mandible, opposite the premolar teeth.

(*j*) Branch of the inferior alveolar nerve to molar roots, receiving strong communicating branches from the retromolar fossa.

Type 1 (6 of the 8 mandibles)

In this arrangement (Fig. 2) the inferior alveolar nerve was a single large structure lying in a bony canal. In two mandibles the tips of the molar roots projected into the canal, so that the branches supplying these roots were very short and direct. Subsequently the nerve terminated in a mental arborization, with offshoots to the plexus adjacent to the incisor teeth. The branches of supply to the canine and incisors were always found in a deeper (inner or posterior) position, and were offshoots from a large branch of the main nerve given off just before it entered the mental foramen. The incisor plexus, while connected to the branches mentioned, was not the source of the dental branches. In addition, each specimen clearly displayed thick down-turning branches, from both the dental branches and from the incisor plexus,

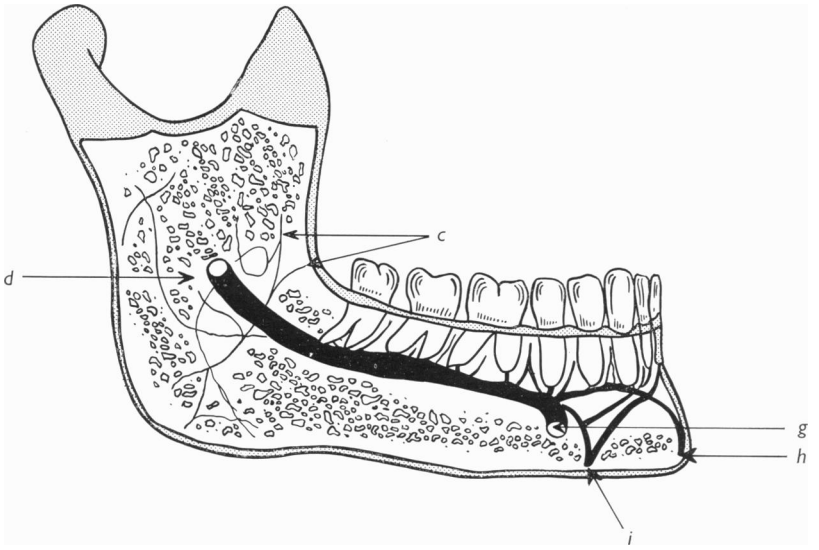

Fig. 2. Type 1 arrangement of the inferior alveolar nerve. For key see Fig. 1.

leading to foramina on the inner surface of the mandible opposite the premolar teeth. These foramina were described by Shiller & Wiswell (1954), and provide a route for communication between branches of the mylohyoid nerve and the incisor plexus or the dental branches of the inferior alveolar nerve. In one of our specimens such a connexion was clearly demonstrated. Additional prolongations of the plexus can be traced to foramina, also described by Shiller & Wiswell (1954), near the midline on the posterior aspect of the symphysis, either above or below the genial tubercles.

Slightly different arrangements were found in two of these six mandibles. The undivided nerve was situated a little more inferiorly, and its branches to the teeth were arranged in a plexus between the nerve and the roots, instead of being direct offshoots to the roots. In one of these dissections the plexus gave off branches to the periodontal and gingival structures.

Type 2 (1 of the 8 mandibles)

Here the nerve was situated substantially lower down in the mandible (Fig. 3), some distance from the roots of the molars. The dental branches were given off more posteriorly, and were consequently longer and more oblique in position that in type 1. The further course of the nerve was as described in type 1.

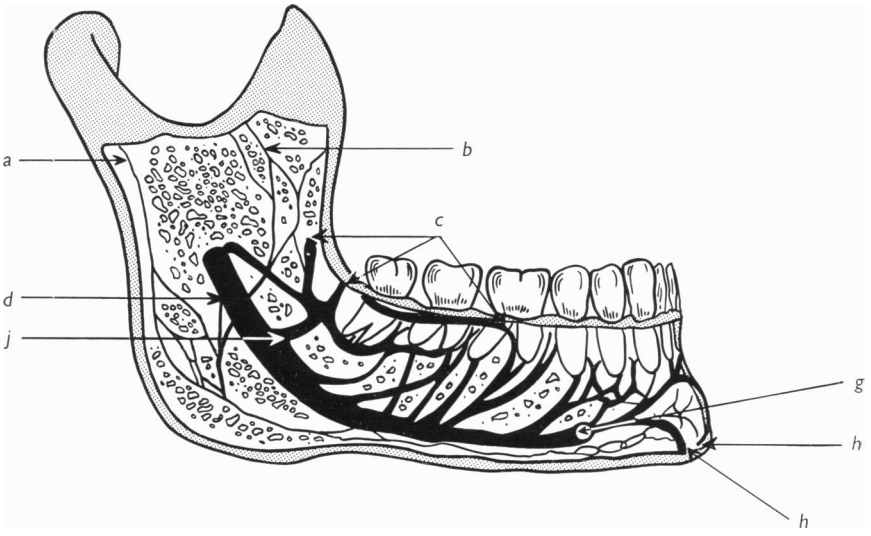

Fig. 3. Type 2 arrangement of the inferior alveolar nerve. For key see Fig. 1.

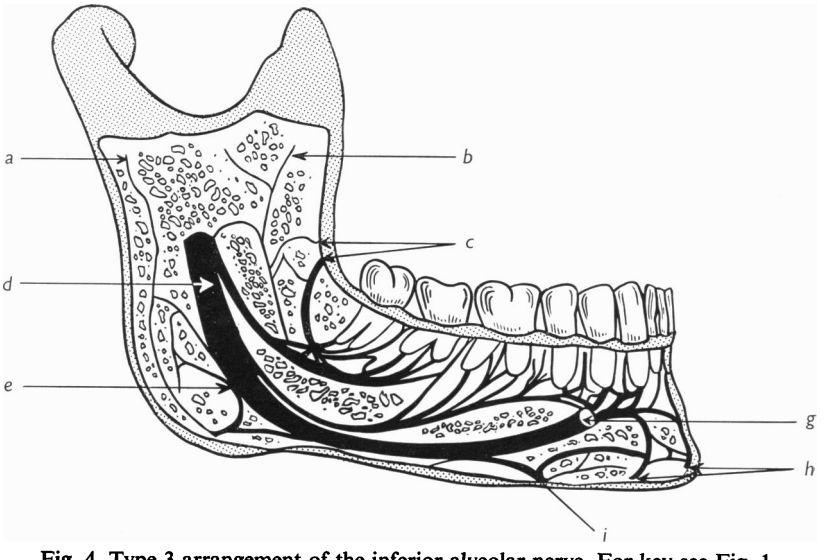

Fig. 4. Type 3 arrangement of the inferior alveolar nerve. For key see Fig. 1.

Type 3 (1 of the 8 mandibles)

In this specimen the inferior alveolar nerve gave off two large branches posteriorly (Fig. 4), which together could be regarded as equivalent to an alveolar branch, while the main continuation of the nerve occupied a more inferior position and continued, as in the other types, towards the mental foramen and the supply of the canine and incisor teeth.

Posterior mandibular foramina

In 62 mandibles from a dissecting-room collection additional observations were made on the smaller foramina to be found on the surface of the posterior part of the mandible. Counting only foramina with an internal diameter 0·1 mm or greater, such foramina were almost always seen near the condyle of the mandible, near the mandibular foramen, and in the retromolar fossa (Fig. 5). The largest of these foramina (internal diameter 0·4 mm or greater) were most commonly seen in the retromolar fossa (one-third of the mandibles) and near the condyle (one-fifth of the mandibles). The foramina were commonly in or near the areas of insertion of the muscles of mastication, and probably transmitted the neurovascular bundles found on dissection.

Radiography

Unilateral radiographs of 80 dried mandibles were made to demonstrate the bony architecture between the mandibular foramen and the molar teeth. Ten of these mandibles were bilaterally radiographed, a procedure which confirmed that the two sides were symmetrically organized. Forty-nine of the 80 radiographs showed a single bony canal (Fig. 6), either near the molar roots or so close that the root tips appeared to penetrate the canal. However, in all of these the margins of the bony canal were complete and unbroken. It seems likely that these mandibles represent the type 1 dissection described above. In 11 of the 80 radiographs a bony canal was seen fairly close to the molar roots, but having a broken upper wall (Fig. 7). It is difficult to decide whether this arrangement should be regarded as representing type 1 or type 2 dissections. The remaining 20 radiographs showed bony patterns lacking definite mandibular canals (Fig. 8), and must be considered as representing dissection patterns type 2 or type 3. The radiographic survey thus broadly confirms the proportions of the findings in the eight dissections.

DISCUSSION

The findings presented here confirm the work of Olivier (1927), who found that in some 60% of dissected specimens the mandibular canal contained the whole of the inferior alveolar nerve, while in the remaining 40% the branches of the nerve were spread out and a distinct canal was not present. They conflict, however, with the observation of Starkie & Stewart (1931) that the inferior alveolar nerve divides posteriorly into two large branches – one supplying the alveolar plexus (and hence the molar, premolar and canine teeth) and the other the incisor teeth and mental region. Inspection of their illustrations suggests that Starkie & Stewart may have

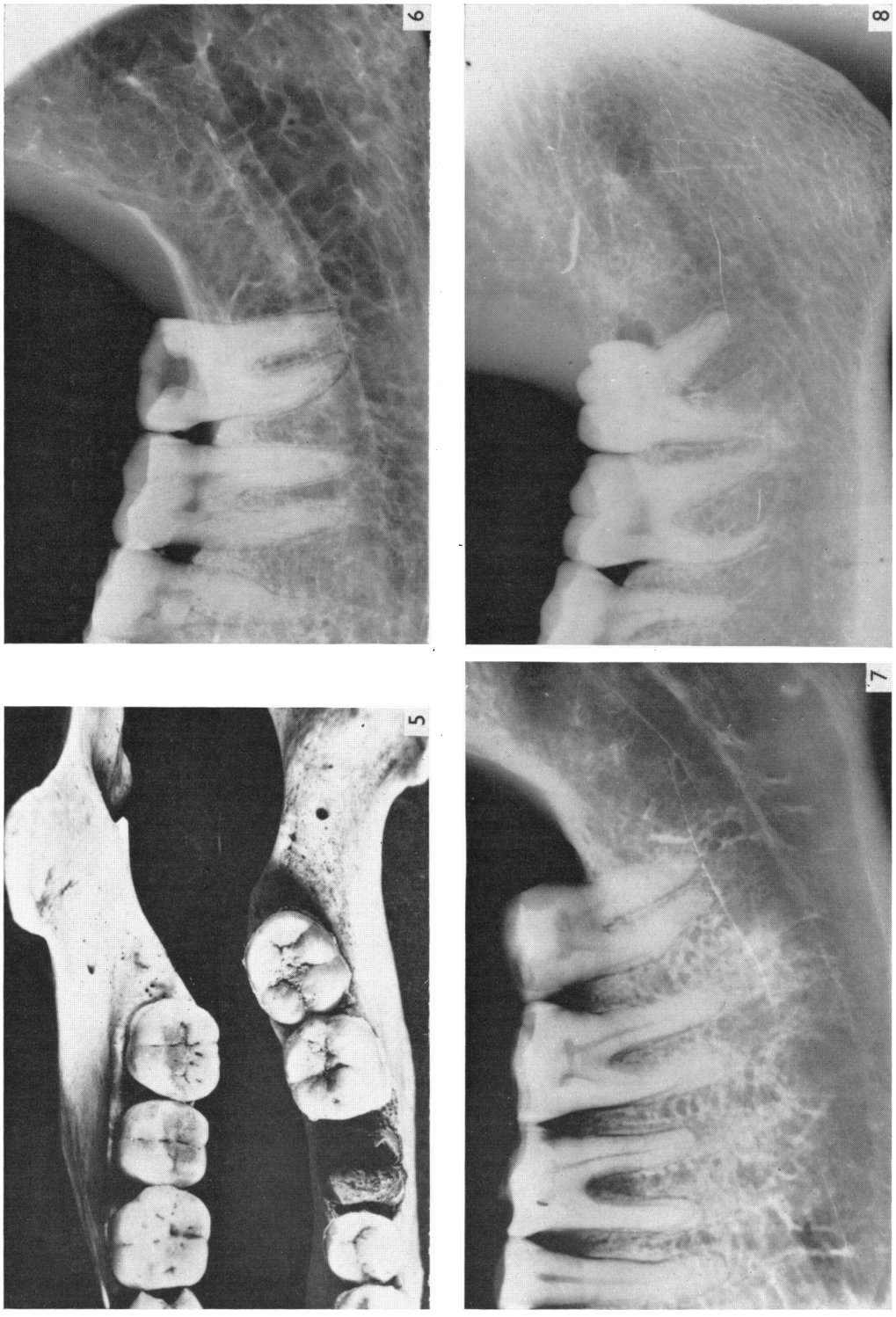

Fig. 5. Accessory foramina in the retromolar fossa.
Fig. 6. Single mandibular canal, with unbroken upper margin.
Fig. 7. Single mandibular canal, with incomplete upper margin.
Fig. 8. No defined mandibular canal seen.

incompletely analysed the arrangement of the nerve in their specimens and this explains why their descriptions differ so markedly from those presented here.

The findings of the present paper also extend previously published accounts (Shiller & Wiswell, 1954; Shirai, 1960) of supplementary foramina in the region of the genial tubercles and below the medial aspect of the premolar teeth, by describing similar apertures in or near the areas of insertion of the muscles of mastication. These foramina, in conveying nervous connexions between the inferior alveolar nerve and the nerves of supply to the temporal and mylohyoid muscles (see also Novitsky, 1938; Shirai, 1960), may provide alternative ('escape') routes whereby impulses conveying pain can continue to be transmitted even after the main trunk of the inferior alveolar nerve has been blocked at the mandibular foramen by the injection of local anaesthetic solution. This concept has been confirmed clinically in patients in whom 'escape' pain persisted after inferior alveolar nerve block but in whom complete anaesthesia was obtained by supplementary infiltration of local anaesthetic solution into the soft tissues overlying the retromolar fossa.

This 'escape pain phenomenon', observed in about 4–5% of all our clinical cases, is not, however, always confined exclusively to the presence of accessory retromolar neurovascular bundles.

In a small number of our cases (less than 1%), even after supplementary infiltration of the soft tissues overlying the retromolar fossa, there was some slight but noticeable residual pain, which seems to indicate the probable functional significance of the neurovascular bundles lying elsewhere, and the need for further anatomical studies.

In these cases, only if requested by the patient, a subzygomatic, extra-oral block injection to the area of the mandibular division of the trigeminal nerve as it emerges from the foramen ovale gave us a completely painless area to work on. We are grateful for these injections to Dr S. M. J. Lewis of the Maxillo-Facial Unit of the King Edward VIII Hospital, Durban.

SUMMARY

1. Dissection of eight mandibles, with the muscles of mastication still attached, demonstrated numerous neurovascular bundles leaving the muscles and entering foramina in their areas of insertion.

2. These 'accessory' nerves formed a plexus in the cancellous bone of the ramus and the body of the mandible lateral to the molar roots and the inferior alveolar nerve.

3. Branches of this plexus seemed to join either the inferior alveolar nerve or its molar branches.

4. Examination of 62 macerated mandibles revealed numerous foramina near the condyles and in the retromolar region, and occasionally also in the region occuped by other muscular insertions.

5. Radiographic examination of 80 mandibles showed a broad agreement with the findings of our dissections.

6. The nervous connexions described must offer an alternative escape route for impulses conveying pain after the main trunk of the inferior alveolar nerve has been

blocked by local anaesthesia. In such cases complete anaesthesia can usually be obtained by the supplementary infiltration of the soft tissues overlying the retromolar fossa. In a small number even this is inadequate, and a complete block of the mandibular nerve may be necessary if pain is to be abolished altogether.

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