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Original Research Article

VARIATION IN THE NUMBER OF NUTRIENT FORAMINA IN LONG BONES OF LOWER LIMB IN CENTRAL INDIA

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ABSTRACT

Background: The major blood supply of long bone is from the nutrient arteries, these nutrient arteries enter the bone through a foramen called nutrient foramen. This is an opening into the shaft of a bone. Nutrient foramen gives passage to the blood vessels of the bone. The nutrient foramen has a particular position for every bone and the direction of foramen is away from growing end of bone.

Objective: The aim of the present study was to study the anatomy and morphology of the nutrient foramina in human lower limb long bones.

Materials and Method: The study was performed on 120 lower limb long bones which included 40 femur, 40 tibia and 40 fibula. The bones were obtained from department of anatomy, R.K.D.F Medical college hospital & research centre and R.K.D.F Dental college & hospital Bhopal.

Results: The variations were found in number and position of nutrient foramen in different lower limb long bones. Double and triple foramina were observed in femur. In few lower limb long bones nutrient foramen was absent.

Conclusion: The knowledge of these foramina is useful in orthopaedics certain operative procedures as well as in plastic and reconstructive surgery, to avoid harm to the nutrient artery.

KEY WORDS: Nutrient Foramen, Nutrient Artery, Femur, Tibia, Fibula.

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INTRODUCTION

The nutrient foramina are the opening into the bone shaft which carries nutrient vessels later lead into canals and usually directed away from the growing end [1]. The major blood supply of the long bone is from the nutrient arteries, which passes through nutrient foramina particularly during the active growing phase in the embryo and foetus, as well as during stages of ossification. [2-4]. The long bones receive about 80% of the interosseous blood supply from the nutrient arteries during childhood, and in their absence,

periosteal vessels supply nutrition to the bones [5]. The blood supply of the long bones generally is carried by one or two diaphyseal nutrient arteries and numerous metaphysial and epiphysial arteries. The diaphyseal nutrient arteries penetrate obliquely in the diaphysis of the long bones, there location and angle being relatively constant dividing into ascending and descending branches [6]. The nutrient canal (through which nutrient artery passes within the shaft) typically become oblique during growth. The direction of the nutrient foramen of each bone is away from growing end [7]. The presence of distinct vascular groove outside the nutrient foramen makes it easily distinguished from other foramens on the bone. [1, 8] Each bone has a particular position for nutrient foramen [9].

The nutrient foramina in femur is directed proximally, positioned on the linea aspera varying in size and number, usually one was located near its proximal end and second at its distal end. The main nutrient artery is usually arises from 2nd perforating artery. If two nutrient arteries present, they may arises from 1st and 3rd perforators [10]. In tibia, a faint vertical line descends downwards from the centre of the soleal line, a vascular groove joins the end of this line and descends downwards into a nutrient foramen. The nutrient foramen usually lies below the soleal line and gives passage to a branch of the posterior tibial artery. The nutrient artery may also arise from the popliteal bifurcation or as a branch from the anterior tibial artery [10].

In fibula nutrient foramen is present a little above the midpoint of the posterior surface and is directed downwards. The vascular supply comes from the branch of the fibular artery [10-13]. A considerable interest in studying nutrient foramina resulted not only from morphological but also from clinical aspects. Some pathological conditions such as developmental abnormalities, acute hematogenic osteomyelitis or fracture healing are closely related to the vascular system of bone [14].

Longia GS et al observed in human long bone the nutrient foramina lies on the flexor aspect [15]. Studying the location and number of the nutrient foramina in long bones is therefore becomes more important in orthopaedic surgical procedures such as fracture repair, joint replacement therapy, bone grafts and vascularized bone microsurgery as well as medicolegal cases [16]. The aim of the present study was to study the anatomy and morphology of the nutrient foramina in human lower limb long bones.

MATERIALS AND METHODS

The study included 120 lower limb cadaveric long bones which included 40 femurs 20 right, 20 left), 40 tibiae (20 right, 20 left), 40 fibulae (20 right, 20 left). The bones were obtained from department of anatomy, R.K.D.F. Medical college hospital & research centre and R.K.D.F. Dental college & hospital, Bhopal. All the bones were observed carefully for number, location and direction of nutrient foramina. Nutrient foramina was identified easily by naked eyes by the presence of a groove leading to them and by a well marked often slightly raised, edge at the commencement of the canal. Only diaphyseal nutrient foramina were counted and studied in all the long bones. Foramina at the ends of the bones were not included in study. Each bone was divided into 3 parts (upper, middle, lower1/3rd) after measuring the length of bone for determining the topographical distribution of nutrient foramen along the length of the bones.

RESULTS

In case of femur 52.5% (21 out of 40) had single nutrient foramen, 22.5% (09 out of 40) had double foramina , 25% (10 out of 40) had triple foramina. Out of 52.5% femur (21 out of 40) nutrient foramen was located on the proximal part of linea aspera in 47.6% (10 out of 21). In 38% (08 out of 21) it was found medial to medial lip of linea aspera in its distal part. But in14% (3 out of 21) it was observed on the distal part of linea aspera. In 22.5% femur (09 out of 40) showing double foramina the location of nutrient foramina was quite different. In 88.9% (08 out of 09), one nutrient foramen was located on the proximal part of linea aspera and another was located on the distal part of linea aspera. In 11.1% femur (1 out of 9) one nutrient foramen was located just below the spiral line and another was medial to medial lip in distal part.

In 25% of femur (10 out of 40) (Fig 1) showing triple foramina, upper nutrient foramen was

located on gluteal tuberosity, middle one was on proximal part of linea aspera and lower one on the medial lip of linea aspera in distal part of it.

Fig. 1: Femurs showing triple nutrient foramina at different locations.

In case of tibiae, 95% tibiae (38 out of 40) had single nutrient foramen, out of these 92% tibiae (35 out of 38) shown nutrient foramen in relation to vertical line on the posterior surface of tibia(fig.2) and 8% (3 out of 38) of cases the nutrient foramen was located near lateral border on posterior surface. The double nutrient foramina was found in remaining 5% tibiae (2 out of 40) one foramen was lying lateral to vertical line and another was located on the medial border at the middle of shaft.

Fig. 2: Tibia showing single nutrient foramen on vertical line.

With respect to fibulae, we observed that 72.5% of fibulae (29 out of 40) shown single nutrient foramen. Out of which 55% of fibulae (16 out of 29) shown nutrient foramen in relation with posterior border and 45% (13 out of 29) of cases shown nutrient foramen in relation with medial border. The 25% of the fibulae (10 out of 40) (Fig 3) had found double nutrient foramen. Out of which 60% of fibulae (6 out of 10) had foramen located on the posterior border. The 20% of fibulae (2 out of 10) had 1 foramen on posterior surface, 10% of fibulae (1 out of 10) shown both the foramen located on medial border and 10% (1 out of 10) of fibulae shown both foramen located on medial surface. 10% of the cases (1 out of 10) shown 1 nutrient foramen on posterior border and 1 foramen on anterior surface. In the remaining2% (1 out of 50) of the cases, triple nutrient foramen was observed and all 3 nutrient foramen was located on posterior border near the middle of the shaft. In the present study none of the fibulae found with the absence of nutrient foramen.

Fig. 3: Fibulae showing double nutrient foramen at different location.

DISCUSSION

Many researcher reported that majority of femur studied had a single foramen in most specimen. [8,17-18]. Some researchers observed that the majority of femurs had double nutrient foramina[6,11] According to other researchers, the double nutrient foramen of femur was observed in 60% ,[2] 42.8%,[19]46%[20] and 55.6% cases.[21]Some authors found triple nutrient foramina in femurs.[6,19] Some authors have observed multiple nutrient foramen up to 6 to 9 in their studies[20] while in some studies nutrient foramina was absent [11, 18].

In the previous studies have reported single nutrient foramen in 90 % of the tibiae, they have reported the presence of double nutrient foramina in some of the tibiae [13, 18, 26]. In case of fibulae, single nutrient foramen was reported in 86.4%, [13] 94%, [22] 94.9% [23] and 100%. [2] The absence of nutrient foramina in long bones is well known [19, 24]. It was reported that in incidence where the nutrient foramen is

absent, the bone is likely to be supplied by periosteal arteries [4]. In previous studies double nutrient foramen was observed in 11.7% cases [19] and triple foramina were observed in one fibula [13].

Hence the knowledge of nutrient foramen is important for orthopaedic surgeons preoperatively to preserve the circulation in open reduction of fractures, joint replacement therapies and in bone graft surgeries.

Conflicts of Interests: None

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