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Arterial Vascularization of the Hind Limb Muscles in the Japanese Quails (*Coturnix coturnix japonica*)

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Abstract: This study was carried out with the aim of investigate the arterial vascularization of the hind limb muscles in Japanese quail (*Coturnix coturnix japonica*). In this study, 15 items quail were used. The method of latex injection was administered. Arterial vascularization of the hind limb was supplied by external iliac artery and ischiadic artery. The external iliac artery was terminated by dividing circumflex femoral artery and femoral artery and which course it had given umbilical and cranial gluteal artery. The ischiadic artery had been the thickest vessel nourishing the leg. During the course, it was given caudal gluteal, obturator, deep femoral, superior nutrient and caudal femoral artery. Popliteal artery was the continuation of the ischiadic artery. The inferior nutrient artery, medial tibial artery, peroneal artery, ramus tibialis, ramus fibularis, cranial recurrent tibial artery and lateral tibial artery arose from the cranial tibial artery. The genu suprema artery was raised from medial tibial artery. Rete tibiotarsale was shaped by the branches of cranial tibial artery at distal level of tibiae and artery tarsalis lateralis et medialis were taken out of from this network. The lateral recurrent tibial artery was raised from lateral tarsal artery. The medial tarsal artery had given out caudomedial and caudolateral metatarsal artery and on the cranial surface of metatarsus extremitas proximalis by unifying with lateral tarsal artery, it has shaped dorsal pedal artery. The craniolateral and craniomedial metatarsal artery were taken the origin from this vessel and perforating metatarsal artery from craniolateral metatarsal artery.

Key wods: *Coturnix coturnix japonica*, hind limb, artery, vascularization, ischiadic artery, Turkey

INTRODUCTION

The quail is a common name of the birds including the species of *Coturnix*, *Anurophasis*, *Perdicula* and *Opheresia* of Phasianidae family. The importance of quail is great as regards that it is an important resource of hunting tourism and protection of national balance and meat production of commercial purpose. In addition, in recent years, it is started to be used as experimental subject which has existed the determination of the significance of its anatomical structure and difference (Chail *et al*., 1975; Collins *et al*., 1970; Okamoto, 1981). After the aorta made aort arc at different levels according to species in the birds, it reaches at median line on the row of the fourth rib and it goes to backward as aorta descendens. Later, aorta descendens gives external iliac artery bilaterally at articulatio coxae level and pars synsacralis called as aort.

During this vessel goes towards the caudal, it gives internal iliac artery and it takes the name of median caudae artery (Baumel *et al*., 1993; Kurtul, 2004; Nickel *et al*., 1977). From the onset of aorta descendens to the last branch dividing place, it gives a lot of branches vascularising body wall and structures surrounding the spine (Kurtul, 2004). The branches of external iliac and ischiadic artery supply of arterial vascularization of hind limb. External iliac artery is divided at articulatio coxae level and anterior of femur from aorta descendens to dexter and sinister iliac artery. Before the vessel was left body cavity while it was in kidney tissue, it gave circumflex femoral artery feeding extensor muscle of knee joint and gives pubic artery.

After external iliac artery left pelvis cavity, it takes the name of femoral artery (Baumel *et al*., 1993; Dursun, 2002; Getty, 1975; King and Mclellend, 1984; Kurtul, 2004; Nickel *et al*., 1977). The ischiadic artery is thick and main vessel carrying clear blood and turning bilaterally from aorta descendens to the back part of femur level. After the vessel had given middle and caudal renal arteries, it gave the branches called ramus ureterodeferantialis medii feeding ureter and ductus deferens. Thereafter, ischiadic artery had left from pelvis cavity via ischiadic foramen while it extended from the leg to the toes; it gives a lot of branches in order for the feet to be fed (Baumel *et al*., 1993; Dursun, 2002; Getty, 1975; King and Mclellend, 1984; Kurtul, 2004; Nickel *et al*., 1977).

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The aim of this study is to determine arterial vascularization of the hind limb the quails by means of latex injection and dissection methods.

MATERIALS AND METHODS

In this study, 15 Japanese quails (*Coturnix coturnix japonica*) provided from Veterinary Faculty of Ataturk University and without making consideration of gender were used in this study. With the aim of premedication to the materials after at the dose of 5-10 mg rompun was given, keta's by i.m. at the dose of 20-40 mg kg^{-1} was injected after anesthesia (Flecnell, 1992; Samuel *et al*., 1997). By opening the chests of the animals in order the prevent the coagulation of the blood, intracardially 2500 I.U. heparin was given under deep anesthesia, the heart was cut from the apex, the blood was evacuated. It was washed by the water of 10% physiologic water. Latex colored with red clothing stain was injected from left chambers via aorta (Hassa, 1967). Later, the hind limbs were kept in fountain water at room temperature, the coagulation of latex was provided. After this process, the branches given by external iliac artery and a. ischiadic artery were dissected. In order for cadavers not to be gone off during imagination, taking result and dissection, they were kept in formaldehyde solution of 10%. For the terminology, Nomina Anatomica Avium (Baumel *et al*., 1993) was used.

RESULTS AND DISCUSSION

The external iliac artery was originated from bilaterally aorta descendens at the level of medial division of the kidney at the level of 4-5 synsacral spine (Fig. 1). While the vessel was gone in the pelvic cavity caudolaterally, it gave umbilical artery and cranial gluteal artery and then it was cased by turning to femoral artery and circumflex femoral artery. The umbilical artery (Fig. 1) rose from lateral faces of external iliac artery. It went through ventral surface of pubis bone and dispersed to caudofemoral muscle via internal obturator muscle.

The gluteal cranial artery protrudes from external iliac artery dorsal space at the same level with umbilical artery and that deep gluteal muscle, medial gluteal muscle and cranial gluteal artery fed the cranial section. The femoral artery (Fig. 1) was a branch divided from external iliac artery in the cranial of the hip joint. It was observed that the vessel extended to flexor surface of knee joint with a going of caudoventral. It was seen that it made anastomozes with a genu suprema artery in articulatio genu medially. Thereafter, it was distributed to the pectineus muscle, vastus medialis, iliacus muscle, gemelli muscle, rectus femoris muscle and adductor muscle.

The circumflex femoris artery (Fig. 1) was the follower vessel of external iliac artery. Thereafter, it was given a branch to sartorius muscle. It was supply to quadriceps femoris muscle after the vessel had passed the bone crossly from distal 1/3 level of femur; it extended from medial to lateral and patella and dispersed in tensor fascia latae muscle. It was determined that 2 cm after aorta descendens had given external iliac artery (Fig. 1), the thickest vessel which fed the leg; it gave ischiadic artery (Fig. 1 and 2). The ischiadic artery was between medial and caudal divisions of the kidney and that it came afterwards middle renal artery and caudal renal artery and in the middle artery of the oviduct in female and deferential artery in males. It was passed ischiadic foramen, left pelvic cavum then following to caudal gluteal artery and then gave obturator artery. It was detected that it gave deep femoral artery at towards femur's caudal proximal 1/3 level, deep femoral artery towards cranial, superior nutricient artery and in bone distal, giving caudal femoral artery, it took the name of popliteal artery.

After ischiadic artery had passed ischiadic foramen, firstly it gave caudal gluteal artery (Fig. 2) and just after the origin of this vessel, it was divided into two branches named ventral and caudal. The ventral branch was semimembranoses muscle with biceps femoris and that caudal branch was semimembranoses and that semitendinosus muscle cranial part and it fed quadriceps femoris and obturator externus muscle. The obturator artery (Fig. 2) was originated from ischiadic artery and that it passed through puboischiadic foramen and fed obturator internus muscle. In proximal 1/3 of the femur, deep femoral artery (Fig. 2) left ischiadic artery gave the branches feding the skin of the region and semitendinosus, semimembranosus, cruralis caudalis and gracilis muscle. The superior nutricient artery (Fig. 2) was originated from cranial surface of ischiadic artery and that it fed semimembranosus with adductor muscles. The caudal femoral artery (Fig. 2) was divided from ischiadic artery on 1/3 of distal of femur and that it gave branches feeding biceps femoris muscle with semitendinos muscle. The popliteal artery (Fig. 2) was a thick vessel in the quality of the following of ischiadic artery and that it ended by dividing cranial tibial artery and caudal tibial artery in caudomedial of knee joint.

The caudal tibial artery (Fig. 2), one of the last branches of popliteal artery was divided into three branches after its origin. These branches gave the branches to the region skin and fed flexor digital medial muscle, flexor digiti II superficialis muscle and flexor II digiti superficialis muscle, semitendinosus muscle and distal part of semimembranosus muscle. The cranial tibial artery (Fig. 2) was a thick vessel in the quality of the

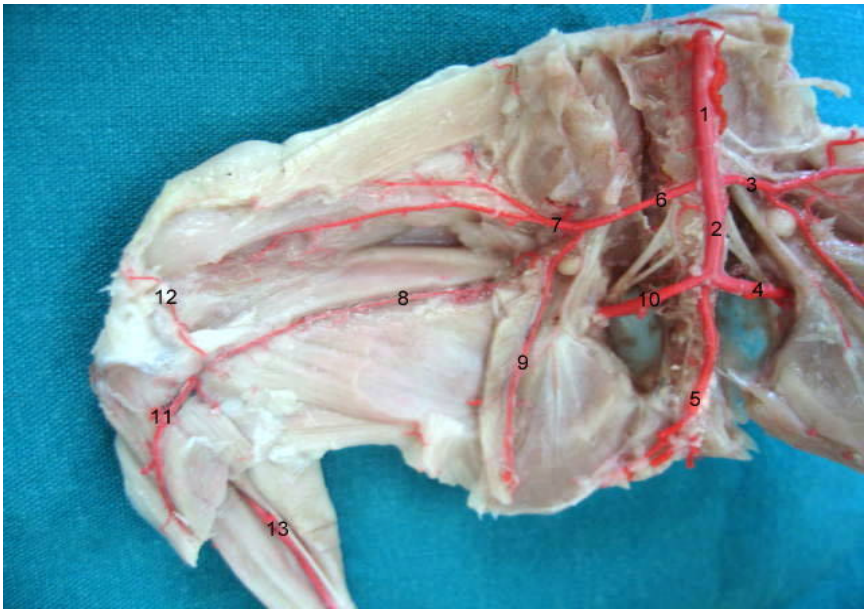

Fig. 1: The hindlimb, medial view. 1-aorta descendens, 2-pars synsacralis aorta, 3-left external iliac artery, 4-left ischiadic artery, 5-middle sacral artery, 6-right external iliac artery, 7-circumflex femoral artery, 8-femoral artery, 9-umbilical artery, 10-right ischiadic artery, 11-medial tibial artery, 12-genu suprema artery, 13-ramus tibialis

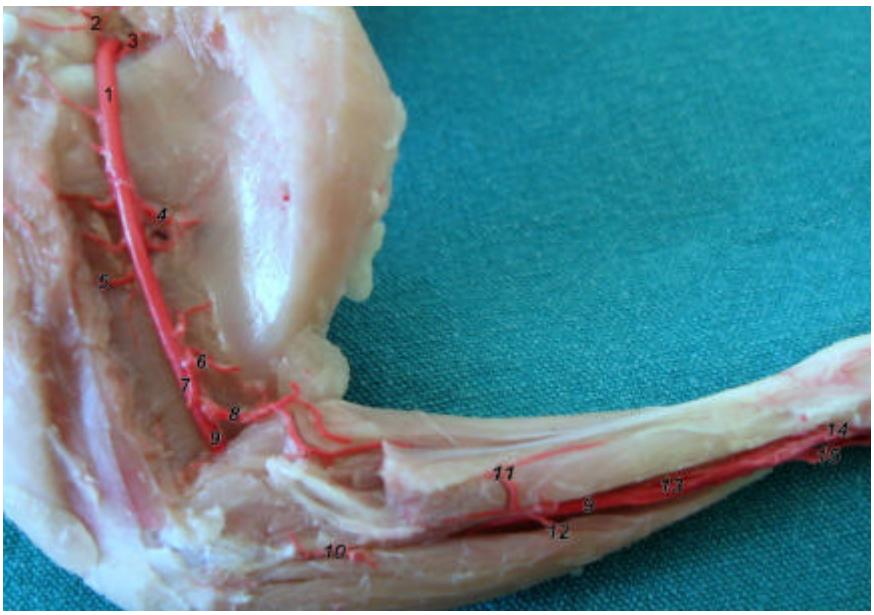

Fig. 2: The hindlimb, lateral view. 1-right ischiadic artery, 2-caudal gluteal artery, 3-obturator artery, 4-deep femoral artery, 5-superior nutrient artery, 6-caudal femoral artery, 7-popliteal artery, 8-caudal tibial artery, 9-cranial tibial artery, 10-peroneal artery, 11-cranial recurrent tibial artery, 12-lateral tibial artery, 13-rete tibiotarsale, 14-lateral tarsal artery, 15-medial tarsal artery

following of popliteal artery and that after its origin, it gave superior nutrient artery, medial tibial artery, peroneal artery and ramus tibialis. By means of interosseal gap of the vessel, it was observed that tibia passed through craniodistal and gave ramus fibularis and cranial recurrent tibial artery on the bone and then lateral tibial artery.

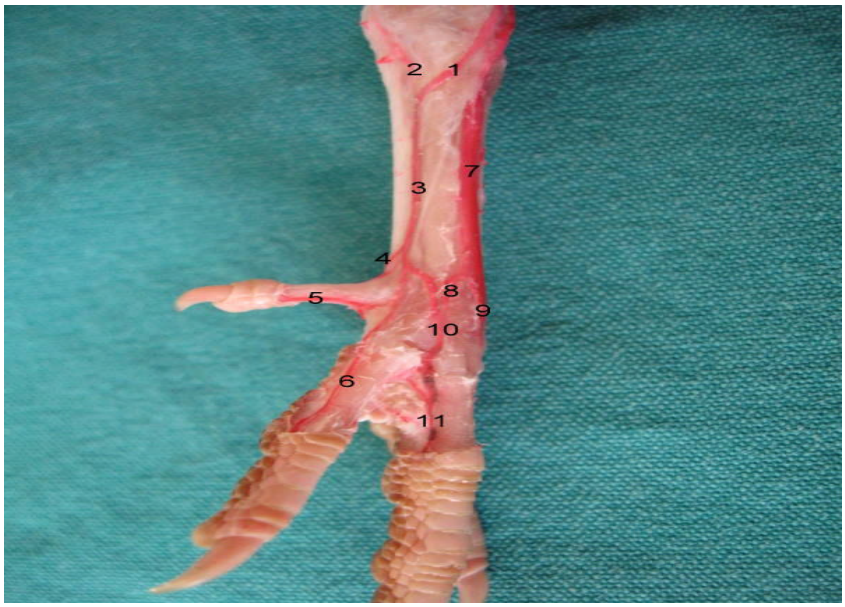

Fig. 3: The hindlimb, dorsamedial view. 1-ramus tibialis, 2-caudomedial metatarsal artery, 3-caudolateral metatarsal artery, 4-digiti I lateral artery, 5-digiti I medial artery, 6-digiti II lateral artery, 7-dorsal pedal artery, 8-craniolateral metatarsal artery, 9-craniomedial metatarsal artery, 10-perforating metatarsal artery, 11-digiti III medial artery

Between the distal of tibia and ossa tarsi after giving a lot of branches occurring rete tibiotarsale, it was found out that it was divided into lateral tarsal artery and medial tarsal artery on cranial of articulatio tarsi and ended.

It was seen that after inferior nutricient artery was divided on 1/3 of femur distal due to tibial cranial artery and distributed on region fascia and semimembranosus muscle. After medial tibial artery took origin from cranial tibial artery in extremitas proximal caudal of tibia (Fig. 1), on the caudal surface of tibia, it was observed that it gave genu suprema artery towards cranial and ended in medial caput of gastrocnemius muscle.

In addition, the genu suprema artery (Fig. 1) took origin from cranial tibial artery on the medial of articulatio genu, it directed to the cranial of the joint and anatomized with the branches femoral artery gave. Also, the vessel made anastomoses with circumflex femoral artery and during its pace vastus medialis muscle, rectus femoris muscle, gastrocnemius muscle, fed medial part of knee joint and medial caput of gastrocnemus muscle.

The peroneal artery (Fig. 2) left from cranial tibial artery and passed from the gap of tibia and fibula and went towards from medial to cranial. During the passing of the vessel, the tibial cranial muscle, extensor digitorum longus muscle and gastrocnemius muscle gave branches feding flexor digiti III superficialis muscle and flexor digiti II superficialis muscle and it made anastomos along with cranial recurrent tibial artery. The ramus tibialis (Fig. 1, 3

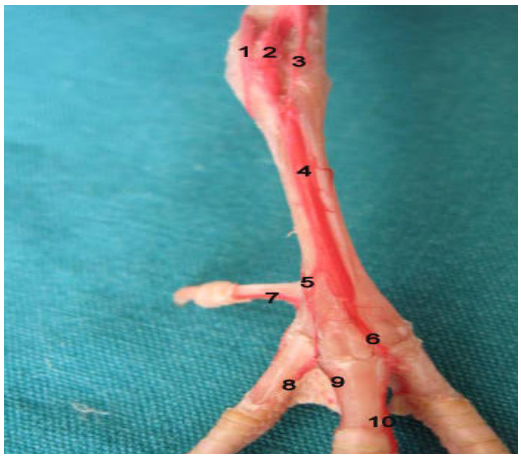

Fig. 4: The hindlimb, dorsal view. 1-ramus tibialis, 2-medial tarsal artery, 3-lateral tarsal artery, 4-dorsal pedal artery, 5-craniolateral metatarsal artery, 6-craniomedial metatarsal artery, 7-digiti I medial artery, 8-digiti II medial artery, 9-digiti III lateral artery, 10-digiti III medial artery

and 4) was originated from cranial tibial artery at the level of extremitas proximalis of tibia on caudal surface of tibia, it went through the distally, fed the tibialis caudalis muscle, flexor hallicus longus muscle and gastrocnemius muscle fed caput medial and medial tibial artery and

caudomedial metatarsal artery made anastomoses together. The ramus fibularis passed through cranial tibial artery following to interosseal gap and throughout caudal surface of fibula, the bone extends to the distal as the flexor muscle tendons in this region were deep and then passed to medial of distal extremitas of tibia. During the passing of the vessel, it was observed that peroneus longus muscle and extensor digitorum longus muscle gave the branches. While ramus fibularis was advanced in interosseal interval, it removed from cranial tibial artery and extended the distal of the bone throughout caudal surface of fibula and it passed into the medial of distal end of tibia as diagonal from the depth of flexor muscle in this region. It was observed that during its progression, the vessel supplied branches to peroneus longus muscle and the flexor digitorum longus muscle. Also, it was given small branches making anastomoses with caudomedial metatarsal artery.

The cranial recurrent tibial artery (Fig. 2) was the first branch of which cranial tibial artery gave after passing interosseal gap fed the muscles in cranial of tibia. It was supply to peroneus longus muscle and flexor digitorum longus muscle and anastomozes with peroneal artery. After the origin of cranial recurrent tibial artery, lateral tibial artery (Fig. 2) left from cranial tibial artery and fed peroneus longus muscle and lateral head of the gastrocnemius muscle. The vessel made anastomoses with lateral recurrent tibial artery; thereafter it gave muscle branches to gastrocnemius muscle with flexor digitorum longus muscle in distal of tibia.

The rete tibiotarsale was a net made up by the branches of cranial tibial artery on the side extremitas cranialis of tibia (Fig. 2) and from that net two branches named lateral tarsal and medial tarsal artery derived. The lateral tarsal artery (Fig. 2 and 4) was one of the branches derived from rete tibiotarsale, it gave lateral recurrent tibial artery soon after its origin starting with the proximal of ossa tarsi, it moved through the lateral surface of ossa tarsi and united with medial tarsal artery in the extremitas proximalis of metatarsus.

The lateral recurrent tibial artery moved on the lateral side extremitas distalis of tibia after it originated from lateral tarsal artery and it made anastomoses with caudolateral metatarsal artery. Besides, it was detected that it gave some branches feeding the lateral part of tibiotarsus. It was determined that medial tarsal artery (Fig. 2 and 4) was the thicker one of the two branches separated from rete tibiotarsale dispread through the distal in the medial of os tarsi by passing under the tendon of cranial tibial muscle and annular ligament which is on the extremitas distalis, tarsometatarsus shaped dorsal pedal artery by uniting with lateral tarsal artery on the cranial side of extremitas cranialis. During the move up to here, it was determined that the vessel gave caudomedial metatarsal artery and caudolateral metatarsal artery. The caudomedial metatarsal artery (Fig. 3) was originated from medial tarsal artery on the medial side of tarsometatarsus and made anastomoses with caudolateral metatarsal artery in distally and with ramus fibularis in proximal by passing the medial foramen which is in the middle 1/3 of tarsometatarsus. The caudolateral metatarsal artery was made anastomoses with lateral recurrent tibial artery by passing the proximal lateral foramen in the proximal of tarsometatarsus and that it was joined perforating metatarsal artery, thereafter it was joined from medial tarsal artery (Fig. 3). The dorsal pedal artery was made up as a result of the unit of the lateral and medial branches derived from rete tibiotarsale in the proximal 1/3 of tarsometatarsus. It was detected that the vessel moved through the distal which is the under the tendon of extensor digitorum longus muscle and that is divided into craniolateral metatarsal artery and craniomedial metatarsal artery in the distal of tarsometatarsus. The craniolateral metatarsal artery (Fig. 3 and 4) was moved through the distal in lateral of tarsometatarsus and gave medial digital artery for the 4th digit and lateral digital artery for the 3rd digit. In addition, it was detected that perforating metatarsal artery was originated from the vessel distal section of tarsometatarsus. It was also observed that perforating metatarsal artery taking onset plantar surface of craniolateral metatarsal artery passed from distal foramen and made anastomoses with a caudolateral metatarsal artery. The craniolateral metatarsal artery took origin from small branches in order to feed the fingers.

The medial digital artery for the 3rd digit, lateral and medial digital artery for the 2nd digit took origin and that craniomedial metatarsal artery was a vessel coming from dorsal pedal artery. In the present study, it was observed that the iliac external artery was given cranial gluteal artery and umbilical artery in the pelvis cavity. Thereafter, it was given circumflex femoral artery and femoral artery.

These findings were confirmed by Fitzgerald (1969). However, Baumel (1975), King and Mclellend (1984) and Kuru (1996) reported that iliac external artery in the wings gave pubic artery in pelvis cavity and then it took the name of femoral artery in the leg. Nickel *et al.* (1977) stated that it was given circumflex femoral artery with cranial gluteal artery and left from pubic artery. Results of this study indicate that the ischiadic artery supplies blood to the aorta descendens. The mentioned artery is similar to the data in the wings (King and Mclellend, 1984; Kuru, 1996) and dug, cock and pigeons (Kurtul, 2004).

However, the reporting of Baumel *et al.* (1993) about that femoral artery become the continuation of iliac external artery in the leg and it become main artery of the leg in the birds such as Cotingidae and Pipridae belonging

to Passarine family and Penguins were in accordance with each other. It was detected that profund femoral artery took origin from ischiadic artery in 1/3 of femur proximal such as those in quail (Fitzgerald, 1969) and wings (Calislar, 1986; Doguer and Erencin, 1964).

Nickel *et al*. (1977) was reported that popliteal artery was divided into cranial tibial artery and lateral tibial artery. Fitzgerald (1969) was also reported that this vessel was divided into cranial tibial artery and caudal tibial artery and was ended. The findings in this study weren't concerned with those of Nickel *et al.* (1977) but they were in accordance with those of Fitzgerald (1969) and Nishida (1963). The result of this study, the caudal tibial artery was one of the last branches of popliteal artery. This finding was confirmed by Baumel (1975), Dursun (2002), Fitzgerald (1969) and by Nishida (1963). Some researchers (Dursun, 2002; Fitzgerald, 1969; Nickel *et al*., 1977; Nishida, 1963) reported that medial tibial artery was not a branch of popliteal artery. It was after inferior nutricient artery origins and took rose from cranial tibial artery. It was reported that genu suprema artery took origin from medial tibial artery in medial of articulatio genu (Sisson, 1975; Tasbas, 1985). Similar finding are observed.

CONCLUSION

In the present study, it is determined that peroneal artery was raised onset from cranial tibial artery. Fitzgerald (1969) and Nishida (1963) were reported that same findings. Although, Nickel *et al*. (1977) was reported that peroneal artery was raised from popliteal artery.

Dursun (2002) and Fitzgerald (1969) were stated that the rete tibiotarsale was constituted by branches of cranial tibial artery. According to Baumel (1975), in the avian; it was constituted by ramus fibularis and branches of cranial tibial artery. The results are similar to those reported by Dursun (2002) and Fitzgerald (1969).

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