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Anatomical aspects of biopsy of the proximal fibula

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Abstract The relationship between the peroneal nerves and the anatomical structures near the fibular head were studied in 20 cadavers. It was the purpose to define the boundaries of a “safe” area when performing a biopsy of the fibular head. The distances between the proximal end of the fibular head and the deep peroneal nerve (26 ± 0.32 mm) and the intermuscular septum (15 ± 0.19 mm) were measured, as well as the angle between the deep peroneal nerve and the fibula as seen in the A-P view ($23.5\pm3.5^\circ$). We considered that biopsies should be performed with an anterolateral approach in the safe area formed by the fibular head and the deep peroneal nerve in the anterior compartment.

Résumé La relation entre les nerfs péroniers et les structures anatomiques autour de la tête fibulaire a été étudiée sur 20 cadavres. Les mesures suivantes ont été faites: (1) la distance entre l’extrémité proximale de la tête fibulaire et le nerf péronier profond (26 ± 0.32 mm), (2) la distance entre l’extrémité proximale de la tête fibulaire et la cloison inter musculaire (15 ± 0.19 mm), et (3) l’angle entre le nerf péronier profond et la fibula considéré sous la vue A-P ($23.5\pm3.5^\circ$). Nous avons considéré

que les biopsies devaient être conduites avec l’approche antérolatérale dans la région sans risque formée par la tête fibulaire et les nerfs péroniers profonds dans le compartiment antérieur.

Introduction

During bone and soft tissue tumour surgery it is important to preserve limb function while performing adequate resection of the tumour. As the superficial and deep peroneal nerves are the most important structures in relation to bone tumours of the proximal fibula, it is important to avoid damaging them during biopsy. There are few anatomical studies of this area in the literature [4] and the purpose of our research was to delineate clearly the safe area as well as to describe safe biopsy techniques for tumours of the proximal fibula with preservation of the superficial and deep peroneal nerves.

Materials and methods

Forty limbs of 20 Japanese cadavers were studied, and of these 12 were women and 8 were men. Their mean height was 161.2 cm. The normal anatomy of the deep and superficial peroneal nerves was investigated and a safe biopsy route identified.

To establish clearly the boundaries of this safe area, three indices (Fig. 1) were measured: (1) the distance between the proximal end of the fibula and the deep peroneal nerve; (2) the distance between the proximal end of the fibula and the intermuscular septum; (3) the angle between the deep peroneal nerve and the axis of the fibula as seen in the anteroposterior view.

In addition the anatomy of the peroneal nerves was also studied during operations on bone tumours with cortical expansion or soft tissue extension. Seven patients with tumour expansion of the cortex or extension into the soft tissues were included and the peroneal nerve was always identified and preserved. There were three cases of osteosarcoma, one malignant fibrous histiocytoma of bone, one giant cell tumour, one fibrous dysplasia, and one example of metastatic bone tumour from lung cancer.

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Fig. 1 Three indices to clearly establish the boundaries of the safe area (1 distance between the proximal end of the fibula and the deep peroneal nerve, 2 distance between the proximal end of the fibula and the intermuscular septum, 3 angle between the deep peroneal nerve and the fibular axis as seen in an anteroposterior view)

Fig. 2 Photograph of peroneal nerves (F head of fibula, * proximal muscular branches to the tibialis anterior muscle, black arrow deep peroneal nerve, white arrow superficial peroneal nerve, TA tibialis anterior muscle)

Results

After removal of the peroneus longus, peroneus brevis and extensor digitorum longus muscles, many branches from the anterior tibial artery and vein are found anterior to branches of the peroneal nerves. After removal of these vessels the peroneal nerve is seen to run in a posterolateral to anteromedial direction just below the head of the fibula and to divide into three branches (Fig. 2). It is difficult when using a posterior or lateral approach to avoid the peroneal nerve which runs obliquely across the epiphysis of the fibula. Biopsy through an anterior approach is also difficult because the compartment of the extensor digitorum longus muscle is small and the tibialis anterior artery passes deep to the tibialis anterior muscle. Therefore, biopsy should be performed by an anterolateral approach through the safe area in the compartment of the peroneus longus muscle bounded by the head of the fibula and the deep peroneal nerve (Fig. 3).

The mean values of the three indices were 26 ± 0.32 mm for the distance between the proximal end

Fig. 3 Safe area (horizontal hatching) for biopsy of the proximal fibula

of the fibula and the deep peroneal nerve; 15 ± 0.19 mm for the distance between the proximal end of the fibula and the intermuscular septum; $23.5 \pm 3.5^\circ$ for the angle between the deep peroneal nerve and the fibula as seen in the AP view. In this safe area many branches of the tibialis anterior artery and vein spread out like a spider's web. We also noted an average of 2.7 nerve branches to the tibialis anterior muscle in this area.

When the tumour had expanded to the cortex or extended into the soft tissues in relation to the proximal fibula, we found that the peroneal nerves had shifted posteriorly and distally in the operative field. In this event the area must be enlarged posterolaterally.

Discussion

When an osteosarcoma has responded well to pre-operative chemotherapy as revealed by radiography, good limb function can be achieved by appropriate excision [5]. The superficial and deep peroneal nerves and lateral collateral ligament can be preserved when a marginal excision is performed in the proximal fibula [6]. It is therefore necessary to protect the peroneal nerves and lateral collateral ligament from contamination by tumour tissue during biopsy. This applies both to benign lesions as well as to malignant bone tumours (especially osteosarcomas) and biopsy should be performed through the anterolateral approach in the safe area that we have described.

The spider's web of branches from the anterior tibial artery and vein require coagulation in order to prevent contamination and haematoma formation. When a malignant bone tumour is suspected, we prefer to use a fine needle biopsy in order to avoid these possible complications [1, 2, 3].

We also studied the anatomy of bone tumours of the proximal fibula with cortical expansion or soft tissue expansion. In all of the patients the peroneal nerves had been displaced posteriorly and distally in the operative field and this necessitated enlarging the safe area posterolaterally.

The nerve branches to the tibialis anterior muscle in this safe area are inevitably sacrificed but there is no loss of function as there is adequate innervation by branches of the deep peroneal nerve.

In conclusion, biopsy of bone tumours of the proximal fibula should be performed through this safe area, even when the tumour has expanded to the cortex or extended into the soft tissues.

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