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Brief Report

Fascial deformation in the lateral elbow region: a conceptual approach

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Summary

In embalmed preparations, the antebrachial fascia in the lateral elbow region is shown to be deformed by load application to the triceps muscle. From this fascia, muscles arise which are primarily concerned with the extension of wrist and fingers. In the case of lateral epicondylitis (tennis elbow), the superficial site of attachment of these extensors at the lateral epicondyle is extremely painful. Triceps training may help to diminish (or prevent) this pain by altering the forces acting at the lateral epicondyle.

Relevance

The antebrachial fascia is an important site of attachment for muscles involved in grasping and pinching. Knowledge of the relations between muscles and fascia in this area might be of importance in prevention and therapy of tennis elbow.

Key words: Tennis elbow, lateral epicondylitis, fascia, triceps muscle, anatomy, biomechanics

Introduction

The importance of (deep) fascias for both load transfer and as sites of attachment for muscles is difficult to grasp from anatomical text and picture books[1-8]. This is not surprising: it is much easier to create pictures or drawings showing bony attachment sites of muscles.

This pilot study focuses on the fascia in the lateral elbow region, a site of much clinical interest[9]. The muscles attached to this fascia are primarily concerned with the extension of wrist and fingers[10] and are active during movements like grasping and pinching[11]. Because of the vast connections between certain extensor muscles and the antebrachial fascia, we were especially interested as to whether underdevelopment of the fascia could imply an increased load transfer to the common extensor muscle.

A previous study addressed why in particular the origin of the extensor carpi radialis brevis muscle could be affected in tennis elbow[10]. The present study addresses the possible role of the fascia in transferring forces around the lateral elbow, by studying the effect of applying loads to the brachial fascia through the triceps muscle.

Methods

In 23 human bodies embalmed by vascular perfusion[10], brachial and antebrachial fascia were exposed by blunt dissection, as far as possible. The fascias in the lateral elbow region were macroscopically compared.

In five specimens the antebrachial fascia distal to the lateral epicondyle of the humerus was calibrated with surface markings 10 mm apart and a grid 10 × 10 mm was overlaid. The surface markings and the grid are defined in Figure 1. The arabic numbers at the top of Figure 1 refer to the distance (cm) distal to a transverse plane passing through the lateral epicondyle of the humerus. The bodies were lying supine, with the elbow

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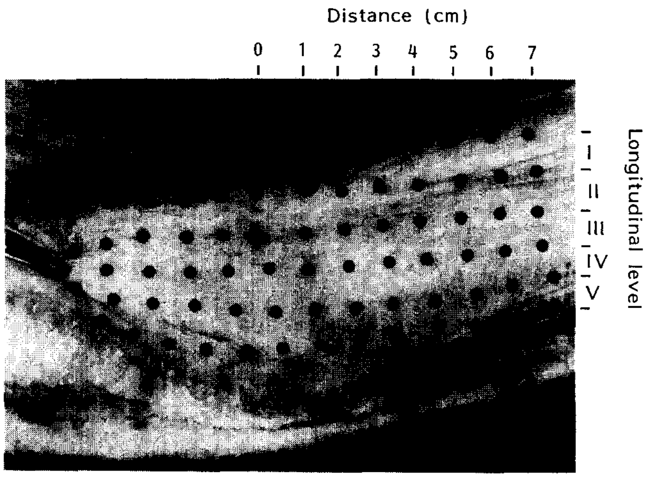

Figure 1. Right arm of an embalmed specimen with (adapted) calibration of the fascia. The numbering of the grid is defined with respect to the lateral epicondyle (+). On the left, part of the tweezer can be seen attached to (and pulling at) the combination of brachial fascia and triceps tendon.

in the light flexion normally present after embalmment. The roman data on the right of Figure 1 refer to longitudinal levels at a distance of 10 mm from each other.

The immobilized preparations were constantly moistened. An adapted tweezer was mounted to the combination of triceps muscle and brachial fascia. The sites of tweezer attachment (Figure 1) were localized 5 cm proximally to the line which passes through the lateral epicondyle (line 0). Forces of 5 N (as preload), 50 N and 70 N were applied to the tweezer, pulling in the direction of the shoulder.

At preload and 10 s after the start of loading, the specimens were photographed with a camera, located lateral to the lateral epicondyle (at a distance of 350 mm). We recorded deformation of the antebrachial fascia by comparing for each square the width and the height at preload, 50 N and 70 N. We defined a site of deformation as a square from which the width and/or height differed at least 0.5 mm from that at preload.

Results

The antebrachial fascia in the lateral elbow region differs within and between individuals. Macroscopically visible differences in thickness are obvious, but notwithstanding these differences, the fascia in the lateral elbow region is in all specimens strongly developed. In certain specimens the fascia is markedly strengthened by collagenous strands, mostly oriented in a longitudinal direction. The fascia is aponeurotic where the proximal parts of extensor digitorum, extensor carpi ulnaris and to a lesser extent extensor carpi radialis longus muscle attach to the fascia.

By simultaneously loading triceps muscle and brachial fascia in the direction of the shoulder, the fascia proximal and distal to the lateral epicondyle is deformed. In Figure 2 an overview is given of the sites of deformation distal to the lateral epicondyle. As to be expected, the areas showing deformation depend on both the amount and the direction of force applied.

In comparing the total number of squares showing deformation at the loading of 50 N and of 70 N (Figure 2), the increase at 70 N is obvious (from 81 squares at 50 N to 149 at 70 N). This increase amounts to 46%. Loading at different sites (the arrows in respectively A, B, C and D) results in deformation within different but overlapping areas of the antebrachial fascia. For example, traction in A results in deformation predominantly at the levels I–III. In C and D the site of the traction has been shifted to the centre of the tendon of the triceps muscle. This results in deformation within more dorsally (ulnar) located areas (levels III, IV and V). The fascia in this area covers the proximal portion of the (dorsal part of the) extensor digitorum, of the extensor carpi ulnaris and also of the anconeus.

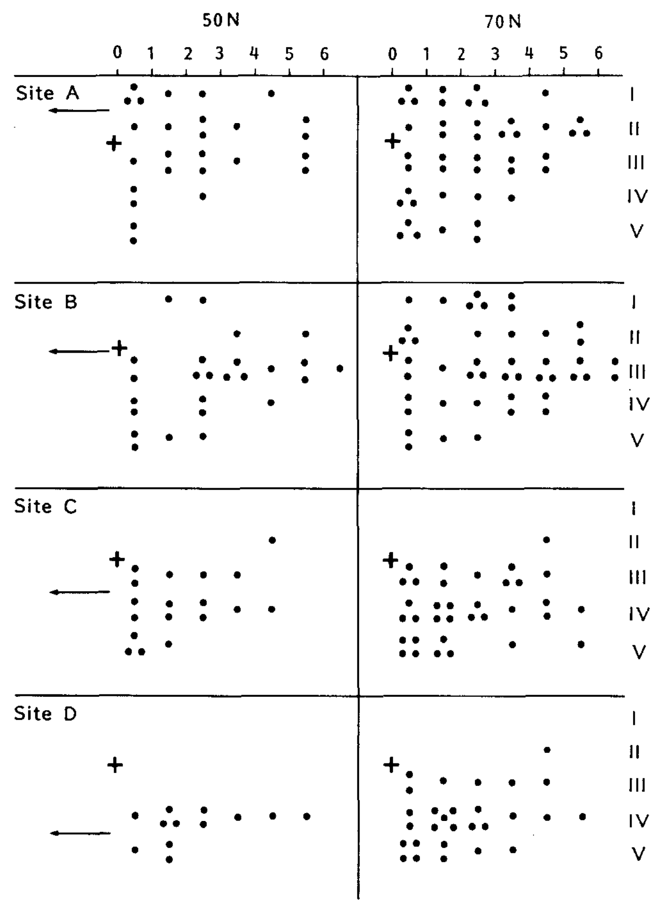

Figure 2. Deformation of the antebrachial fascia with pulling forces of 50 and 70 N at sites A, B, C and D. The arrows indicate the levels of the pulling forces; they are actually applied 5 cm proximal to the lateral epicondyle (+). Numbers on top and at right refer to the calibration as shown in Figure 1. Distal to (*i.e.* at the right side of) the lateral epicondyle, each fascial area showing deformation is represented by a dot. Each dot reflects fascial deformation in that particular area of one arm. At maximum, five dots are present per area since deformations for comparable areas were added up for five arms.

Discussion

Expressions such as 'brachial fascia' and 'antebrachial fascia' may suggest that these fascias are separate entities. However, this (formerly called deep) fascia is a single continuous layer which forms the walls of the muscles of the arm and forearm[12]. At several sites, muscles or tendons are connected to the fascia in such a way that only sharp dissection can separate them. Yet, these intimate relations are readily neglected if by dissection or in the mind of the observer structures are artificially segregated into separate muscles, tendons, intermuscular septa and fascia.

The intimate relationship between antebrachial fascia and extensor muscles in the lateral elbow region of the elbow begs the question of its functional significance. The results of the present study show that upon application of traction to the triceps and the brachial fascia, certain parts of the antebrachial fascia undergo deformation. This suggests that one of the functions of the triceps is to tense the antebrachial fascia. By bracing the fascia where it gives rise to the extensors of the wrist and fingers, the triceps could function to relieve some of the load that would otherwise be applied directly to the lateral epicondyle through the common extensor origin. Because of their connections with the antebrachial fascia, this holds especially for the load transfer from the extensor digitorum muscle and the extensor carpi radialis longus muscle. Both muscles connect to the common extensor muscle[10]. Direct transfer from the extensor carpi radialis brevis muscle to the fascia can only be slight; its muscle belly is located more distally, and there the antebrachial fascia is poorly developed.[10].

In tennis elbow, the common extensor tendon, which is also called the tendon of the extensor carpi radialis brevis muscle[10], is frequently damaged at the tendoperiostal junction[13]. In terms of the above synthesis it is conceivable that injury to the common extensor tendon could occur if the antebrachial fascia failed to dissipate the force of the wrist extensors. This might arise if the antebrachial fascia was poorly developed or if the triceps failed to contract synchronously with the wrist extensors. Conversely, in the treatment of tennis elbow, there could be a place for training the triceps in an attempt to strengthen the fascia and protect the lateral epicondyle from excessive stress. However, this conjecture cannot be resolved on the basis of morphological data alone. Appropriate clinical studies need to be devised to explore further the role of triceps and antebrachial fascia in protecting the common extensor origin.

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