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Three-Dimensional Immersive Photorealistic Layered Dissection of Superficial and Deep Back Muscles: Anatomical Study

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Abstract

Introduction

The distinct anatomy of the superficial and deep back muscles is characterized by complex layered courses, fascial planes, specific vascularization, and innervation. Knowledge of these anatomical parameters is important for some surgical approaches, including lumbar disc herniation, cerebrospinal fluid fistula repair, vascularized muscle pedicle flaps, and posterior fossa extra-intracranial bypass. In the present study, we use modern techniques of three-dimensional (3D) surface scanning to help better illustrate the layered anatomy of the back muscles.

Material and methods

We dissected in layers *the back muscles of one cadaver*. Every step of the dissection was 3D scanned using a technique called photogrammetry, which allows the extraction of 3D data from 2D photographs. The 3D data were processed using Blender software, and the 3D photorealistic models were uploaded to a dedicated website for 3D visualization. This allows users to see the 3D models from every desktop or mobile device, as well as augmented (AR) and virtual reality (VR) formats.

Results

The photorealistic 3D models present the back muscles' anatomy in a volumetric manner, which can be visualized on any computer device. The web 3D features, including AR and VR, allow users to zoom, pan, and rotate the models, which may facilitate learning.

Conclusion

The technology of photorealistic surface scanning, modern 3D visualization possibilities of web-dedicated formats, as well as advances in AR and VR, have the potential to help with a better understanding of complex anatomy. We believe that this opens the field for further research in the field of medical education.

Categories: Neurosurgery, Anatomy
Keywords: plastic surgery, virtual reality, augmented reality, back muscles, neurosurgery, anatomy, surface scanning, photogrammetry

Introduction

The gross human anatomy of the back muscles is distinct with specific layered structure, particular innervation, and vascularization depending on the type of muscle: extrinsic (superficial) or intrinsic (deep) back muscles. This layered structure can be difficult to understand when studied from traditional two-dimensional (2D) atlases because one cannot easily recognize the complex three-dimensional (3D) relationships of the soft tissue layers, individual muscle courses, intermuscular fascial planes, muscular attachments, and the related neurovascular anatomy from flat photographs and schemes presented from only one angle of view.

Recently, there has been a growing trend of publications of 3D anatomical models that are created with the help of different methods of surface scanning techniques [1,2]. One such technique, called photogrammetry, is one of the ways to create such photorealistic 3D models. Photogrammetry consists of a process of surface scanning that utilizes standard photographic equipment for the generation of volumetric 3D data [1-3]. This process is highly resource-intensive in terms of computational power, but if the photographs are captured using a modern high-megapixel camera and post-processed accordingly, the result can represent a highly accurate photorealistic 3D model. Photogrammetry is widely used in geography in order to generate a 3D landscape from low-altitude aerial photographs [4,5] or in archeology in order to 3D map excavations or create 3D spatial reconstructions of historical monuments [6]. Neurosurgery is a relatively new application