A common morphological variation in the knee insertion of the extensor digitorum longus muscle reduces maximal force production but does not affect other contractile properties

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Anecdotally there have been reports from laboratories around the world of mice which show a different morphological attachment of the *extensor digitorum longus* (EDL) muscle to the knee, with the muscle splitting into the normal tendon insertion and a group of muscle fibres which insert into the fascia just below the knee. In over 25 years of using the isolated mouse EDL muscle in our Laboratory we have noted this phenomenon in control mice C57BL6/10, dystrophin knockout mice and C57BL6Actn3 KO mice. We believe this to be a natural variation rather than the result of any disease or injury event. During the normal process of dissecting an EDL muscle with an extraneous fascia muscle insertion separate from the main tendon the tendency is just to cut off the extra tendinous fibres near the bone, in most cases inadvertently. The remaining intact, tendon to tendon, section of the EDL functions normally and exhibits no abnormal run down.

Our present study investigates the functional significance in terms of force generation of the split insertion of the EDL at the knee joint. Animals with a C57BL6Actn3 (Actn3) knockout and littermate control background were killed with an overdose of isoflurane (UNSW animal ethics approval 11/140B). Muscles were dissected out and then tied to a force recording rig (Aurora Scientific) at room temperature. In EDL muscle with extra-tendinous fibres, the extra tendinous fibres were cut near to the bone.

In our inbred colony of Actn3 knockout (KO) mice; 7 out of 8 KO and 9 out of 15 littermate control mice had extra-tendinous EDL fibres inserting into the fascia below the knee. Maximum tetanic force produced by each morphology group showed a significant drop in force production (P=0.006) when the EDL tendon is fused). The rate of fatigue development and recovery was also not affected by the cutting of the extra-tendinous fibres. Muscle kinetics showed no differences in time to peak and half relaxation time.

These results may explain the wide variation of maximal isometric force reported in isolated EDL muscles.