

**Influence de l'amplitude d'un raccourcissement durant un tétanos
sur la force isométrique redéveloppée
immédiatement après l'arrêt du mouvement,**

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Translation from French

**Influence of the amplitude of a shortening during a tetanus
on isometric force redeveloped immediately after cessation of the
movement,**

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The sartorius muscles (*Rana temporaria* or *esculenta*), bathing in Ringer (NaCl: 116 mM, KCl: 2 mM, CaCl₂: 1.8 mM, phosphate buffer: 1.9 mM, pH 7.3 with O₂), 16°C, are tetanized for 2.52 s by alternating capacitor discharges at a frequency of 25 / s, applied by a grid of ten platinum electrodes (to ensure simultaneous activation of the muscle over its entire length).

A series consists of fourteen tetani at intervals of 900 s.

The first and last tetanus are isometric at a "short" length is called l_c ; the force is measured 0.5 sec after the beginning of the tetanus; the mean of the two measurements is called P_c , and serves as a reference for the following tetani.

Shortly before the second tetanus, the muscle is extended by 0.44 mm. This tetanus is isometric during the first half-second, then the muscle is shortened by 0.44 mm at a constant rate of 0.255 cm / s, and is thus brought back to the initial length l_c . The muscle regains some isometric force during the last part of the tetanus. The total duration is sufficient for this redeveloped force to reach a maximum and to remain there for at least 1 second. This maintained force is extrapolated until the moment when shortening begins, and this extrapolation is measured (P_d).

The following tetani are similar to the second one, but the variation of length is increased in steps of 0.44 mm to the seventh, and then decreased from the same level to the thirteenth. We calculate the mean of the P_d measurements on the tetani whose variations in length are equal (second one and 13th one, third one and 12th one, and so on ...).

This experimental "mirror" plane attenuates the effects of fatigue of the muscle which affects each successive tetanus, which is rather weak since the strength of the last tetanus is on average 7% less than that of the first. The extrapolation corrects the drop of force during the tetanus itself, so that P_d and P_c are compared at the same time of contraction.

We have observed that the redeveloped force (P_d) is always less than the isometric force at the same length (P_c). The deficit is a linear function of the amplitude (Δl) of the shortening. Expressed in per cent of the length of the muscle (l_0 , defined as the longest possible muscle length *in situ*), the results correspond to the equation:

$$\frac{P_d}{P_c} = 1 - d \frac{\Delta l}{l_o}$$

The parameter d varies from 1.0 to 1.5. If $l_c = l_o$, we find 1.36 ± 0.24 ($n = 4$) and 1.34 ± 0.11 ($n = 4$) in two experimental series.

It seems that the parameter d depends on the starting length. We find, in fact, that $d = 1.03$ for $l_c = l_o - 4\text{mm}$; 1.26 for $l_c = l_o - 2\text{mm}$; 1.38 for $l_c = l_o + 2\text{mm}$ and 1.55 for $l_o + 4\text{mm}$ (each value being the average of 4 experiments).

In conclusion, the force maintained during an isometric tetanus is not only a function of the length of the muscle. It also depends on a possible movement during the tetanus. The influence of the speed of this movement is already well. (Abbott and Aubert, 1952, Buchthal, 1942, Plaghki and Maréchal, 1971), but the effect of the amplitude of movement had not yet been reported.

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