

Force Patterns on the Oarlock

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Although every coach knows that various propulsive effects can be produced by different strokes, it is almost impossible to decide what rowing stroke is most suitable because many technical details about boat speed and propulsion are not fully understood. In our research we found that the quantitative parameters of the rowing stroke are very great, but the measurement of force on the oarlock indicates differences that can be reduced to three basic types of force application.

Figure 1: Curves demonstrating three typical force patterns on the oarlock during one rowing stroke.

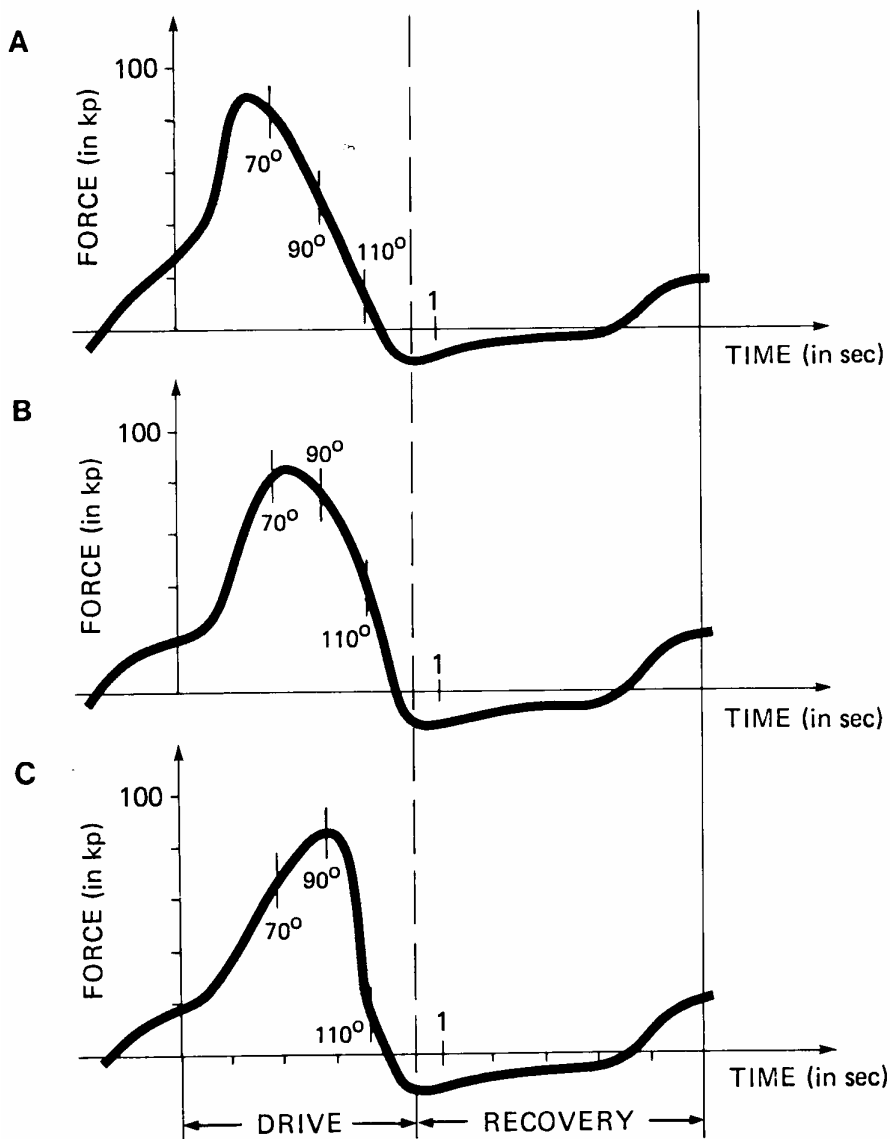


Figure 1-A shows the variant where the catch is stressed. The force application is maximal early in the stroke and then the curve falls off rapidly to the finish. A high power impulse at the beginning and a small one at the finish are characteristic of this variant.

Figure 1-B represents a steady force application throughout the stroke with the pressure point found slowly and carefully. The oarsman tries to maintain the pressure on the blade throughout the stroke and a steady propulsion can be expected. This stroke stresses the central part of the action and is the one we prefer.

Figure 1-C provides an extreme comparison to 1-A. The resistance on the blade is comparatively low during the first part of the stroke and the point of maximum pressure occurs near the end of the drive just before the release. The force application is fully developed at the end of the stroke by accelerating the oar past the central part of the stroke.

Within these extremes there are various possibilities that can be explored, and the relationships between oarhandle speed and boat speed can be established by measuring the two.

Figure 2 illustrates the relationship between the force patterns on the oarlock and the related boat and oarhandle speeds as recorded during a typical racing stroke. The drive is subdivided into three parts according to the duration of the stroke phase during drive. In this figure, "t" represents time, and with $t_1 = t_{\text{CATCH}} - t_{70^\circ}$, $t_2 = t_{70^\circ} - t_{110^\circ}$, and $t_3 = t_{110^\circ} - t_{\text{RELEASE}}$.

Because of oarsman A's hard catch, his oarhandle speed increases rapidly, slackens abruptly, picks up toward the middle of the drive, then drops off. The pressure on the blade evidently decreases soon after the forceful catch, and the boat speed drops sharply. The increases in boat velocity that result are therefore uneven.

Oarsman B begins the stroke with a steadily increasing blade speed which builds during the central phase until the finish when it shows a very strong increase. This profile represents the optimal utilisation of force through the central phase and results in continuously increasing boat speed during the drive.

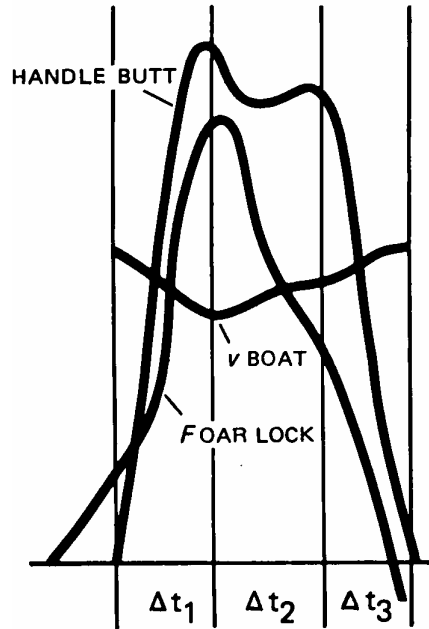
Oarsman C does not show a steady and continuous power curve. He is trying to conserve his blade speed and maximum pressure until the very end.

Based on a consideration of the mechanical features and their interrelationship outlined above as well as practical experience, we established the curve patterns illustrated in Figure 3.

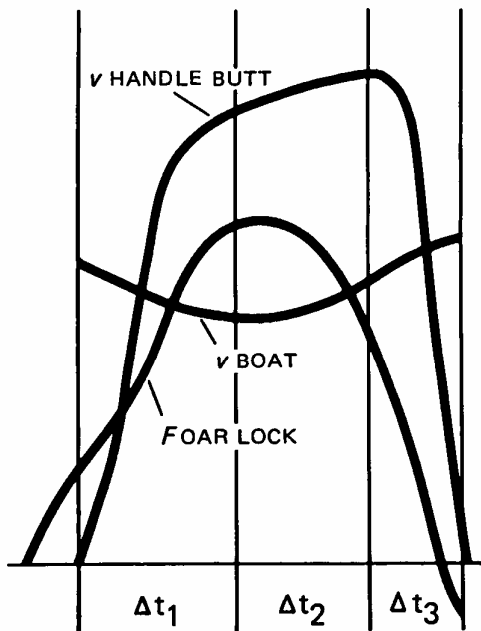
They represent the ideal features of the rowing stroke we are striving for. The external parameters of rowing action (pressure on blade, boat speed, and handle speed) can be accomplished by different variations in body movements. Therefore, the relationship between certain technical variants, which films of various performances have revealed, is of great interest.

One result is indisputable: the oarsman must use his strength for propulsion over the longest possible range.

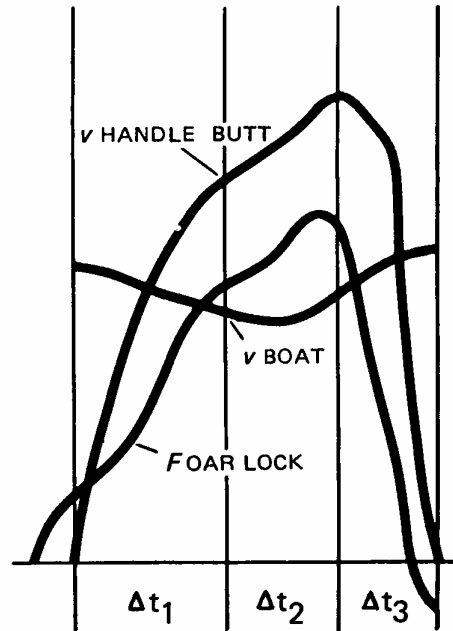
Figure 2: Typical curves showing 1.) the forces exerted on the oarlock, 2.) the speed of the handle butt and 3.) the boat speed during the drive phase of the stroke cycle.



A

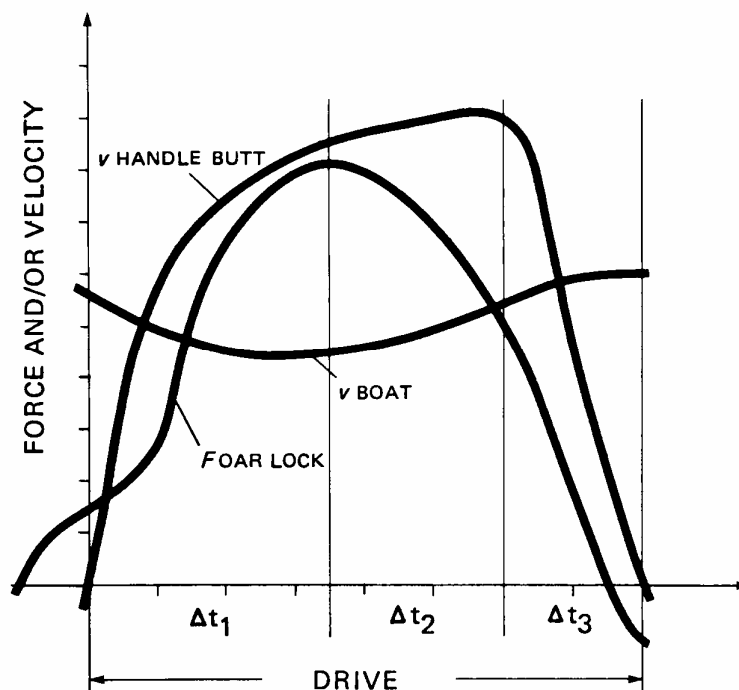


B



C

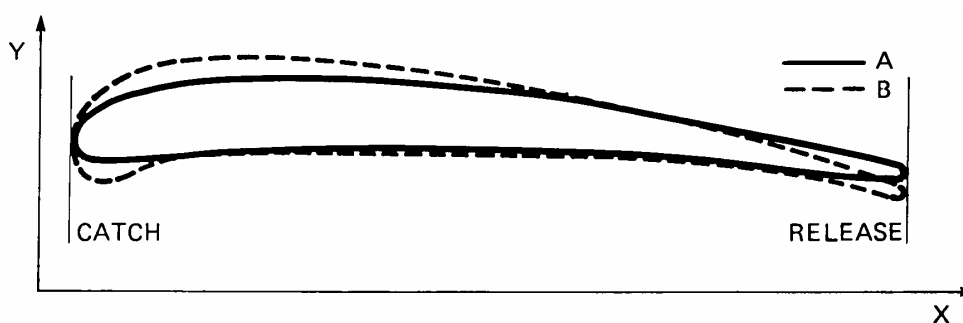
Figure 3: Ideal curves demonstrating the force on the oarlock, the speed of the handle butt, and the boat speed during the drive.



The oarhandle velocity does not depend only on the athlete's physical strength, but also on his ability to drive the oar through the stroke in the correct way. Deficiencies in technique may easily either increase or reduce the blade speed at incorrect times thereby causing inefficient force application.

Figure 4 shows the movements of two oarhandles during one stroke. After analysing films of a large number of oarsmen, the two curves in Figure 4 were chosen to illustrate the correct approach and some common mistakes.

Figure 4: Displacement curve showing the movement of the handle butt throughout a complete rowing stroke.



Oarsman A's oarhandle path does not show any striking peculiarities. The oarhandle's small vertical displacement at the catch indicates that the blade was close to the water before entry. The path is almost horizontal during the drive suggesting a constant blade depth. During recovery, the handle is only slightly off the horizontal. Oarsman A's oarhandle action is correct and will prove efficient provided that the stroke length is also adequate.

Oarsman B shows certain characteristics that can be considered technical deficiencies. The dip in the curve just prior to catch shows that the blade is being "skied" at this point. The oarhandle is too high at the beginning of the drive and too low at the end. The blade digs too deeply after catch and washes out at the finish, thereby reducing the blade resistance too soon.

Comparison of oarhandle curves of many oarsmen suggests that the ideal should approximate that of an airfoil, as does that of oarsman A.

In conclusion, research is revealing much new data on rowing technique, and future research is expected to produce new objective information regarding movements in rowing. This information will further clarify the relationship between body movements and efficiency in rowing, and the coach will be better able to structure his training.

Comments on Körner's Theory of Steady Force Application

Author: Jim Joy (CAN)

The steady force application method has some profound psychophysical implications. From a physical standpoint, this type of approach can lead to a very fluid motion, particularly in the drive phase. The stroke is unhurried which tends to develop a confident, patient oarsman. The shell is not jarred or checked through sharp movements and the oarsman, blade, and shell tend to blend in their movement.

The other attractive aspect of this method is its simplicity in both concept and application - you simply apply even pressure at the points of contact: hands and feet.

A suggested method of observing the effectiveness of these three methods is to test them in a rowing tank with a regular size blade and still water. Experience has demonstrated that the only way you can maintain the co-ordination of the body components on the drive and a continuation of blade movements is to apply the pressure "slowly and carefully." On the other hand, if the oarsman attempts too powerful an entry, the blade slows abruptly after the initial thrust. Oarsman A's hard catch in Figure 1 demonstrates this fact.

The most significant comment of the paper appears when Dr. Körner states, "This profile (oarsman B in Figure 1) represents the optimal utilisation of force through the central phase and results in continuously increasing boat speed during the drive." This is the ultimate test, the effect of the bladework upon the "running" of the shell. The steady pressure bladework maintains a more constant boat velocity. Physiologically, it may prove to be more efficient and to create less unnecessary strain on the body.

The final two figures in Körner's notes (Figures 2 and 3) further emphasise the relative effectiveness of constant blade pressure achieved by acceleration of oarhandle speed. Figure 4 further suggests the more sophisticated aspects of good bladework, that is, blade close to water at entry so there is a minimum of vertical oarhandle displacement and constant blade depth. These are two very important components in "driving the oar through the stroke in the correct way." Too often we are led to believe that effective drive action is purely a function of the oarsman's strength.

This type of conceptual framework lends itself to a gradual, adaptive approach to training. The application of the drive is integrated with the physiological, biomechanical development, and, as indicated earlier in these comments, the psychological impact is a positive one. The oarsman has a confident feel for blade, shell and water.

One final comment, and an area for further research, is that the control and constancy developed on the drive can lead to a similar effect on the recovery. Simply stated, if we attempt to rush the drive, this leads to rushing the recovery, and conversely, a controlled accelerated drive leads to a controlled recovery.

