# A Comparative Analysis of the GDR and Adam Styles

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*Translated and edited by Peter Klavora, Boris Klavora and Alan Roaf*

## Introduction

Coaches, in their attempts to perfect rowing movements, constantly discuss rowing technique. They pursue new developments and search for new and objective data. Rowing technique, however, is only one of several factors involved in performance. In our opinion, rowing performance depends on careful development of four major areas:

- athlete's personality,
- rowing technique,
- overall conditioning of the athlete, and
- equipment.

The rate at which rowing will improve is dependent upon the creative and practical work of the coaches and scientists. Scientific research to find the technical optimum depends on the measurement and research devices available and on an understanding of the factors determining performance. This research must also be carried out on elite athletes if the results are to be valuable. However, the coach cannot depend on this work alone. The coach will never be relieved from the practical search for the technical optimum, and therefore rowing technique will always be a subject of discussion among experienced coaches and coaches just starting to work in the field.

Because of the oarsman's limited mobility in a boat, however, the coach's options are few, and there are certain common misconceptions about rowing technique that can be observed in crews at rowing competitions. In these notes I will discuss the current trends in the length of rowing stroke and its relationship to the length of slides.

## Length of the Rowing Stroke

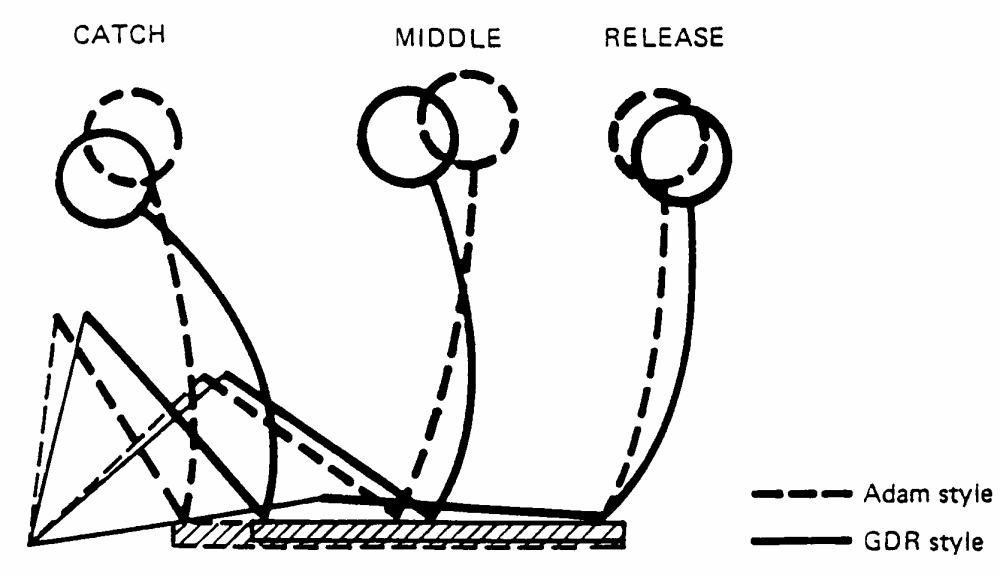
Although no quantitative research data is available at present, it is evident to all observers at recent World Championships and other international regattas that stroke lengths have increased. We estimate that the average sweep stroke length approximates 85 to 90 degrees and the sculling length ranges between 100 and 105 degrees. The arc length of the handle is therefore about 170 cm to 180 cm for sweep boats and 150 cm to 160 cm for sculling boats. This range has been observed in all the top crews, regardless of the technique they use. During the 1976 FISA Coaches' Conference in Stockholm, Dr. Peter Klavora of Canada analysed the three styles that dominated the years 1974-76. He called them **the**

**Adam style, the GDR style and the Rosenberg style.** Our research in 1976 led us to similar results. Essentially, we identified two basic technical variants: **the Adam style and the GDR style.**

The Adam style is characterised by a long slide length of 80 cm and an acute angle of the knees at the catch, both of which result in a reduced initial forward body swing. The GDR style is characterised by a standard slide length of 72 cm which necessitates an extreme forward inclination of the upper body and less knee compression at the catch. The so-called Rosenberg style is also based on a standard slide length of 72 cm and is therefore considered with the GDR style. It has a major fault, however, which is shooting the slide. Therefore, we do not consider this way of rowing a major international rowing style as proposed by Klavora.

Because the GDR style is fairly widespread, we will call the rowing technique based on the slide length of 70 cm to 72 cm the **standard slide technique.** This technique has been in use for some time and evolved from the standard technique of earlier years which was based on a 65 cm slide length. Other components of what was the standard style have remained virtually the same. In the Adam style, however, the **long slide technique** is intended to enhance the oarsman's physical efficiency by changing many of the components of the overall technique. The major differences between the two during the drive phase of the stroke are illustrated in Figure 1.

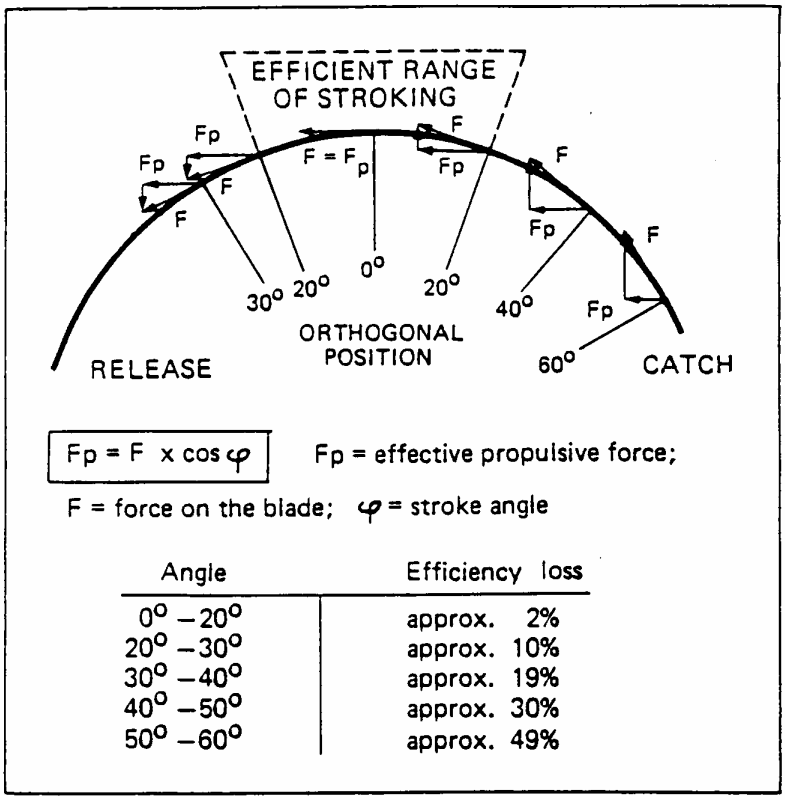
*Figure 1: Differences in body action between the Adam and the GDR rowing styles during the drive phase of the rowing stroke (from P. Klavora, FISA Technical Bulletin, p. 29, 1977).*




Rowing techniques correlate to the length of racing shells. When Karl Adam was developing the long slide technique in the late 1950s and early 1960s, he hypothesised that the more he brought the rowing stroke into the efficient angle, the greater the efficiency of the technique would be. Therefore, he emphasised the central part of the stroke and developed shorter boats that would respond properly to such an application of power. A high rate of stroking was another ingredient for propulsive efficiency with this new technique. This stroke was called the **nucleus**

**stroke** (Kernschlag). It was directed towards a full utilisation of the efficient or economic angle (see Figure 2).

*Figure 2: Efficient (economic) range of stroking and approximate losses in effective propulsive forces at various stroke angles.*




| Angle | Efficiency loss |
|---|---|
| 0° – 20° | approx. 2% |
| 20° – 30° | approx. 10% |
| 30° – 40° | approx. 19% |
| 40° – 50° | approx. 30% |
| 50° – 60° | approx. 49% |

From 1964 to 1968 there was a gradual return to the longer and narrower boats that are being used at present. The longer boats do not react sufficiently to the short quick stroke, therefore the emphasis has changed from the central part of the stroke to what is known as the **long stroke** (Schubschlag). Attempts to develop more propulsion in the longer, narrower boats by lengthening the slide and/or shifting the oarlocks within the economic angle did not lead to any major successes. Research showed that the desirable point of maximum power application should be within the orthogonal range, or right-angle position of the oar to the boat. Therefore, the coach again had to modify the technique to maximise the run of the boat with its new hull shape.

The main task was to lengthen the propulsive phase. Increasing the stroke length in order to give the boat more run, however, put the oarsman once again into an inefficient position. In order to exploit the advantages of reduced resistance inherent in the longer and narrower hull designs, the oarsman had to develop more power throughout the drive and at the finish. Ten degrees more reach at the catch meant that the oarsman had to begin the stroke approximately 50 to 60 degrees in front of the right-angle position; thus the stroke began at an inefficient angle with a loss of available propulsive energy of about 50% (see Figure 2). At present, this power loss cannot be avoided if the stroke length necessary for top international performance is to be reached. For a stroke length of 90 degrees, the catch must be made at about 55 to 60 degrees in front of the right-angle position and the finish must be approximately 30 to 35 degrees behind it. In sculling, the overall arc of

100 to 105 degrees means that the oarsman reaches even further into the inefficient part of the angle; this variation results from the different lever situations and oarlock positions of sculling and sweep rowing. According to our observations, these stroke lengths can be reached by oarsmen using both the standard slide and the long slide techniques.

**The GDR Style or the Standard Slide Technique**

The standard slide technique is based on the optimal co-ordination of three major muscle groups: legs, trunk and arms. The relatively obtuse angle of the knee at the catch position is necessary for extreme forward body swing. Fully stretched arms are also important. The initial push of the legs should be only moderate so that the upper body can move out of the acute angle at the catch without being overpowered.

As Klavora pointed out, the upper body must travel a greater distance than the slide, and the arm pull begins only when the upper body and legs have overcome the greatest resistance, approximately when the hands are just in front of the knees. The co-ordinated action of the three main muscle groups ensures their optimum utilisation throughout the drive. If the legs push too strongly at the beginning of the stroke, the muscles at the acute hip angle will be overpowered and will result in the seat "shooting." Power will not be properly transmitted to the blade and the optimal efficiency of the stroke will be reduced enormously, because the rest of the drive will depend on the isolated action of trunk and arms. The basic disadvantage of the standard slide variant, therefore, is that it does not permit full utilisation of the most powerful muscle group - the legs. This variant also places great stress on the lower spine. The back pains that may result can, however, be helped by appropriate gymnastic and other exercises.

**The Adam Style or the Long Slide Technique**

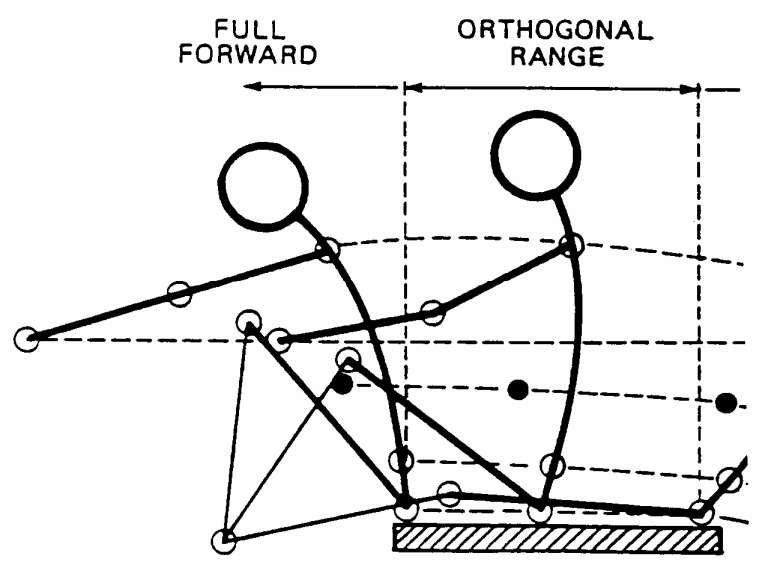
The long slide technique developed by Adam is intended to utilise fully the power of the legs by changing the angle and height of the footboard, as well as its distance from the seat. The acute knee angle at the catch that results from this change and sliding through a longer distance (80 cm) reduces the utilisation of the trunk, but at the same time the danger of pushing the seat is that it is more difficult to couple the arm pull and the very powerful leg drive. A strong and effective finish is thus more difficult to perform. This technique puts a lot of strain on the knee ligaments because of the acceleration of the slide on the recovery that is necessary to develop the acute knee angle at the beginning of the stroke. Furthermore, we emphasise slowing down the slide speed on the recovery so that the upper body is not too harshly absorbed at the catch. The shifts of weight and the position of the centre of gravity during the stroke cycle are aspects that require further research; thus far the problems they present have not been resolved adequately.

Technical variations in international rowing have been reduced to the above two, both of which are based on different views of how best to harness physical performance and efficiency. Both can achieve the stroke lengths necessary for the optimal utilisation of today's boats and therefore both are acceptable.

**Summary**

In summary, the major features of the preferred rowing stroke of our crews are demonstrated in Figure 3 and are the following:

*Figure 3: Displacement of neck, handle and hip during the drive phase of the stroke.*




1. The body should be leaning far forward at the beginning, with an inclination of about 60 to 70 degrees from the horizontal line. The knee angle should be compressed, but not to an extreme position.

2. Legs and trunk should move simultaneously after the catch.

3. The leg push should be combined with a long upper body swing. The arm pull should begin when the hands are about at the level of the knees.

4. Legs and trunk should continue their full range of motion until the finish at which point they stabilise the increasingly strong arm pull.

5. The arms must be pulled forcefully right to the lower ribs.

6. After the blade leaves the water and the hands swing away with the oarhandle, the trunk moves out of the bow and is followed by the seat in an easy and controlled manner. The proper synchronisation of these motions ensures a free shift of the athlete's weight sternwards and results in a smooth run of the boat.

# Force Patterns on the Oarlock

*Author: Theo Körner (GER)*

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.*

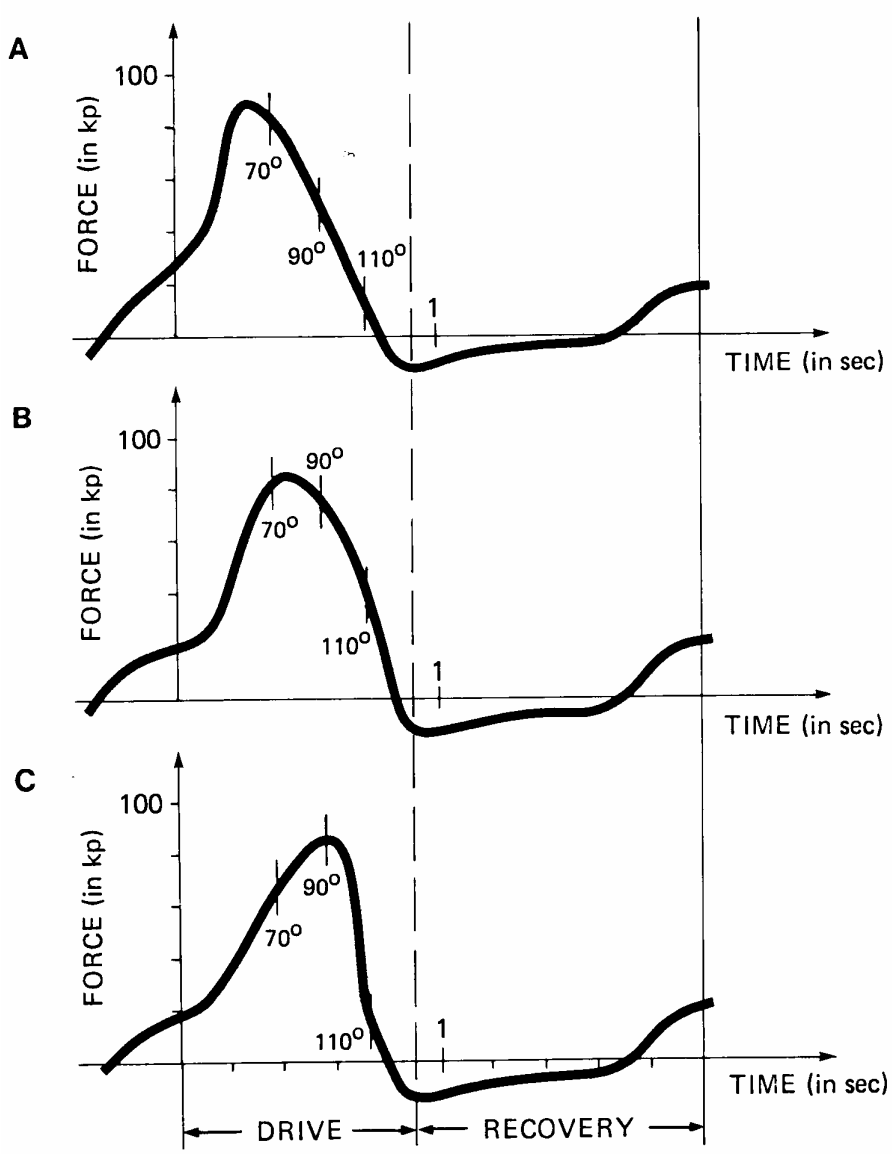


Figure 1-A shows the variant where the catch is stressed. The force application is maximal early in the stroke and then the curve falls off rapidly to the finish. A high power impulse at the beginning and a small one at the finish are characteristic of this variant.

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 t1=tCATCH - t70°, t2=t70° - t110°, and t3= t110° - tRELEASE.

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.

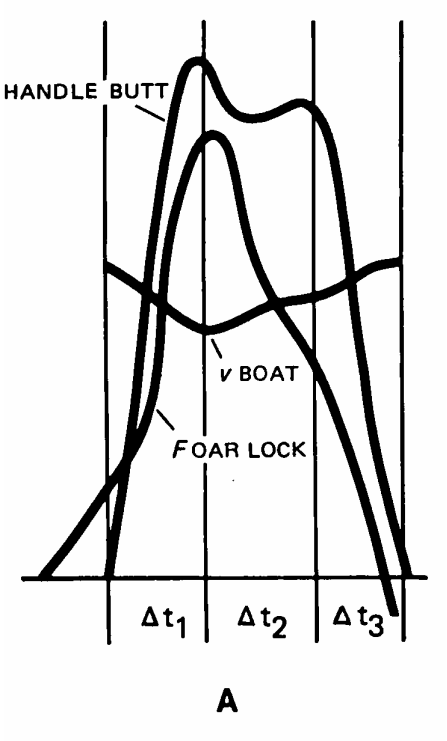
Oarsman C does not show a steady and continuous power curve. He is trying to conserve his blade speed and maximum pressure until the very end.

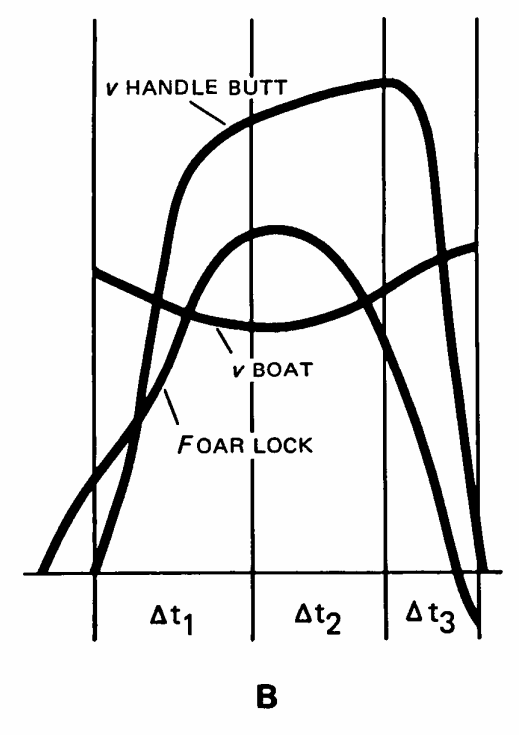
Based on a consideration of the mechanical features and their interrelationship outlined above as well as practical experience, we established the curve patterns illustrated in Figure 3.

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.*



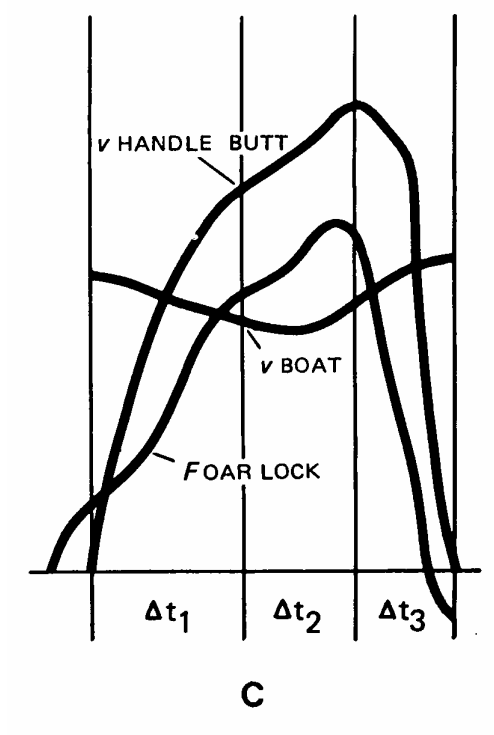
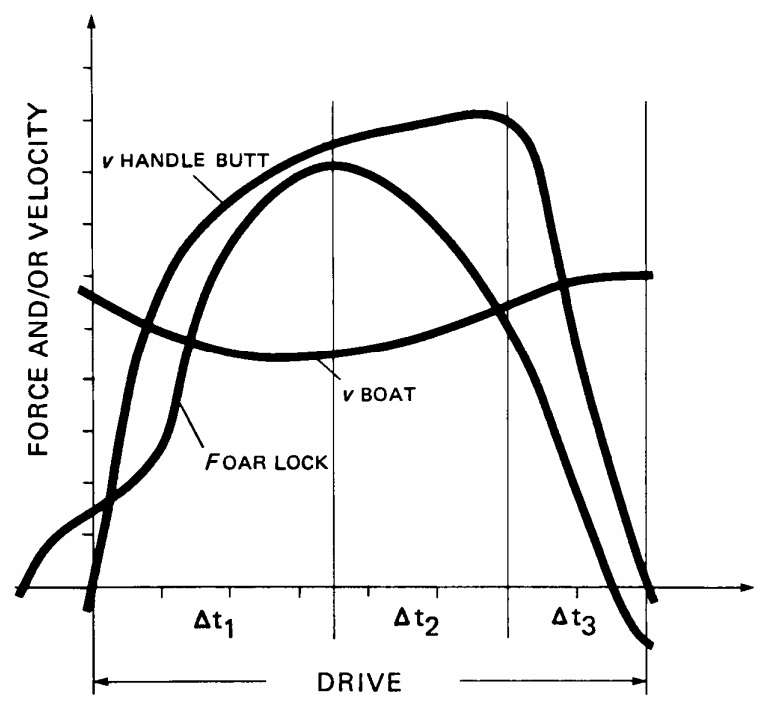



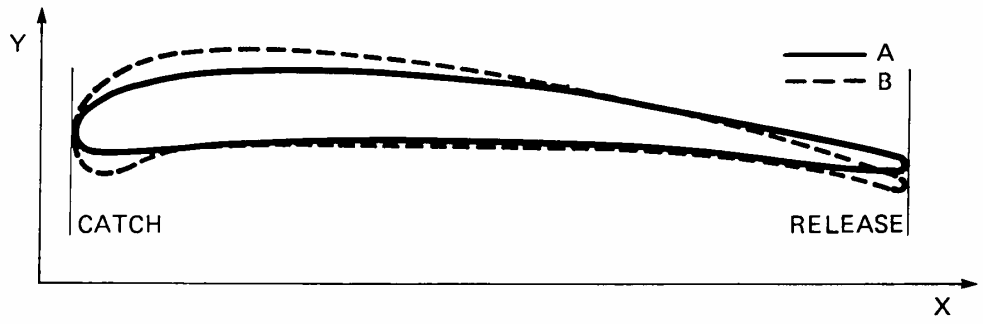
*Figure 3: Ideal curves demonstrating the force on the oarlock, the speed of the handle butt, and the boat speed during the drive.*




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 "skyed" 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.

# An Analysis of Women's Rowing and Sculling Technique

*Author: Penny Chuter (GBR)*

## 1.0 Introduction

### *1.1 Perspective on Technique*

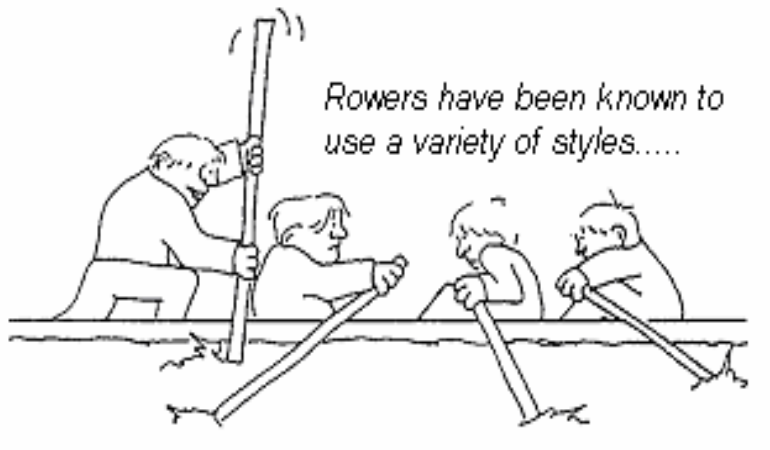



*Fig. 1*

Karl Adam quote: "Training and physiology will give you lengths, whereas good technique will only give you metres."

However, technical efficiency is more important for those with limited physique and physiology. When races are now won and lost by fractions of a second, technique can make the difference between gold and silver.

### *1.2 Technique Variations for Women*

The range on technique variation for women in general does not fall outside the normal range of variability within the sport as a whole.

The fundamental principles are the same, but coaches should adapt techniques to suit the specifics of the individual in terms of height, weight, power and flexibility. If it is assumed that women, on the whole, are shorter and weaker, and more flexible than men, then it can be assumed that women's technique will tend to accommodate these facts.

My basic contention is that women (in general) should row longer than men for the following reasons:

1. If weaker - women need more time during the stroke to develop power.
2. If shorter - women need larger arcs.
3. If less experienced - all rowers achieve less than their full length potential.

In addition, in general, coaches should allow for the facts that:

As the stroke rate increases from winter to summer, there is a tendency for stroke length to shorten.

As a race progresses from start to finish, fatigue also causes a tendency for the stroke length to shorten.

Overall length of stroke is the most important basic principle of boat propulsion. The force of the stroke and the number of strokes per minute are the other two factors. For women (where less strength may be a factor) length of stroke is even more important.

At national and international level, however, my main observation of women's crews in general is that they row too short. The most obvious exception is the women of the former German Democratic Republic, who set an example for all to copy and show clearly that with the right rigging and good technical coaching of the reach forward women can row long.

However, it should be borne in mind that many women competing at international level are not necessarily shorter or weaker than men. Table 1 shows that the average height and weight of the GDR women's team at the 1988 Seoul Olympic Games was 1.83 m (6'0") and 77.6 kg (12 st 3 lb or 171 lbs).

*Table 1: Average Heights and Weights of 1988 GDR Women's Olympic Team*

| Height | | Weight | |
|---|---|---|---|
| Tallest | 1.88 m (6'2") | Heaviest | 84 kg (13 st 3 lbs or 185 lbs) |
| Shortest | 1.77 m (5'10") | Lightest | 68 kg (10 st 10 lbs or 150 lbs) |
| Average | 1.827 m (6'0") | Average | 77.6 kg (12 st 3 lbs or 171 lbs) |

*Table 2: Height and Weight Data for World Championship Medallists - Lightweight Women*

| | |
|---|---|
| Height (minimum) | Approx. 1.67 m (5'6") |
| Weight | Approx. 58 kg (9 st 0 lbs or 128 lbs) |

*Table 3: Single Scull Time Differences*

| Athlete Comparisons | Time Difference |
|---|---|
| Women vs. Men | Approx. 40 seconds slower |
| Lightweight Women vs. Heavyweight Women | Approx. 15 seconds slower |
| Lightweight Women vs. Men | Approx. 55 seconds slower |

Beyond rowing larger arcs in the water, I have no recommendation for adaptation of technique especially for women. Adaptations should be specific to the individual or crew.

### *1.3 Technical Developments - 1976-1990*

*1. Compressed and Orthodox Techniques*

The greatest variation between national techniques worldwide reached its peak at the 1976 Olympic Games in Montreal. There we saw the extreme of what has become known as the Karl Adam "compressed" Technique shown by GBR and FRG crews especially. At the other extreme we saw the orthodox English technique displayed by GDR.

By 1984 those nations using the compressed technique had come full circle and the technique variance between the different nations is now only one of slight differences of emphasis based on the orthodox GDR technique.

*2. Rigger Heights*
Since 1976 riggers have gradually become higher. The reasons will be mentioned later.

*3. Rigger Spreads*

Since the 1960s, rigger spreads first moved towards larger spreads (smaller stroke arcs). This trend also reached its peak around 1976. Since then, and particularly since 1984, spreads have become smaller (larger stroke arcs) again, although not a reversion to the pre-1960s situation. The rationale for these trends will also be discussed later.

*4. Women's Distance - 2000m*

After the 1984 Olympic Games, the distance for women was extended to 2000m. This put a greater emphasis upon endurance and a lesser emphasis on "brute" strength, which has led to a change in women's physiques and in their technique.

There is now much less emphasis on an exaggerated "lie back" at the finish in order to use upper body weight as well as muscular strength to achieve a harder draw. This aspect is still, however, relevant to some women.

*5. Teaching of Technique*

Without doubt, the emphasis upon training which dominated the 1980s has resulted in less attention being paid to technique by coaches. The standard of precision and bladework, even of the GDR crews, is not as high now as it used to be. This is true in many nations, and perhaps it is time that coaches paid more attention to the coaching of efficient technique.

## 2.0 Basic Principles

### *2.1 Body and Boat Principles*

*Compression vs. Reach (Orthodox) Technique*

A. The advantages of full leg compression:

- Use full range of powerful leg muscles.
- Use them in the horizontal plane.
- Exploit the "fast contracting" - fast-twitch muscle fibres.
- Exploit the muscle-stretch reflex as the quadriceps muscles are pre-stretched round the knee joint.

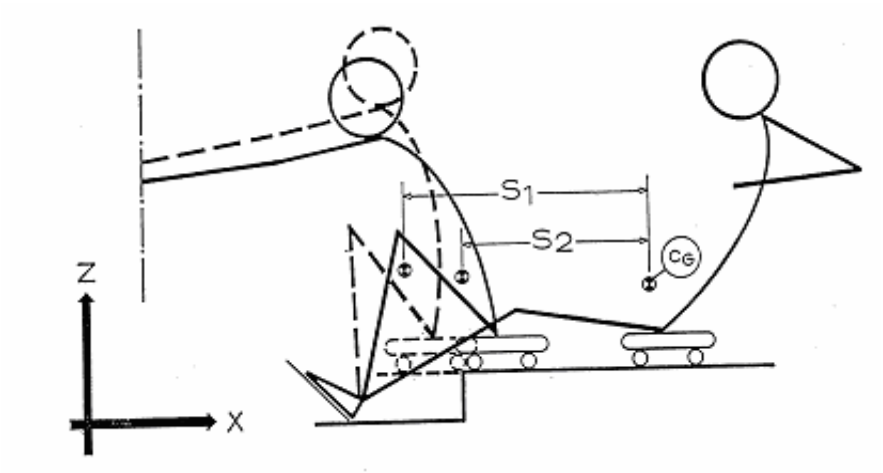



*Fig. 2*

B. The disadvantages:

The muscle fibres of the quadriceps group are also "fast fatiguing" fibres, and if used to maximum through the full range of movement in the early stages of the race, they fatigue earlier, which results in a large fade factor.

Exploitation of the muscle-stretch reflex in the leg extensor muscles contributes further to earlier fatigue.

The upright body position at the catch, in conjunction with the compressed legs, encourages athletes to "lock-on" at the catch with the back instead of the legs. The back muscles are slow contracting and cannot instigate the fast catch so essential to good technique.

In addition, the lack of necessary swing or hip pivot off the backstops encouraged crews to come forward on the recovery with no control - bodies even leaning backwards when crews were rigged with very high feet.

Flexible shoes, which allowed the heels to be lifted in order to achieve full leg compression, were introduced at this time.

There is little "lie-back" at the finish and this at least discourages pitching of the boat fore and aft.

C. In retrospect, this technique encouraged many bad faults to develop and, in GBR where this technique was used in its extreme form during the 1970s, we are still paying the price at club level where coaches who were taught to coach this technique now find it hard to change.

In its extreme, compressed technique encouraged short stroke arcs, no body swing on the recovery, little slide control coming forward, the catch taken with the back and extreme fatigue of the leg muscles building up very quickly.

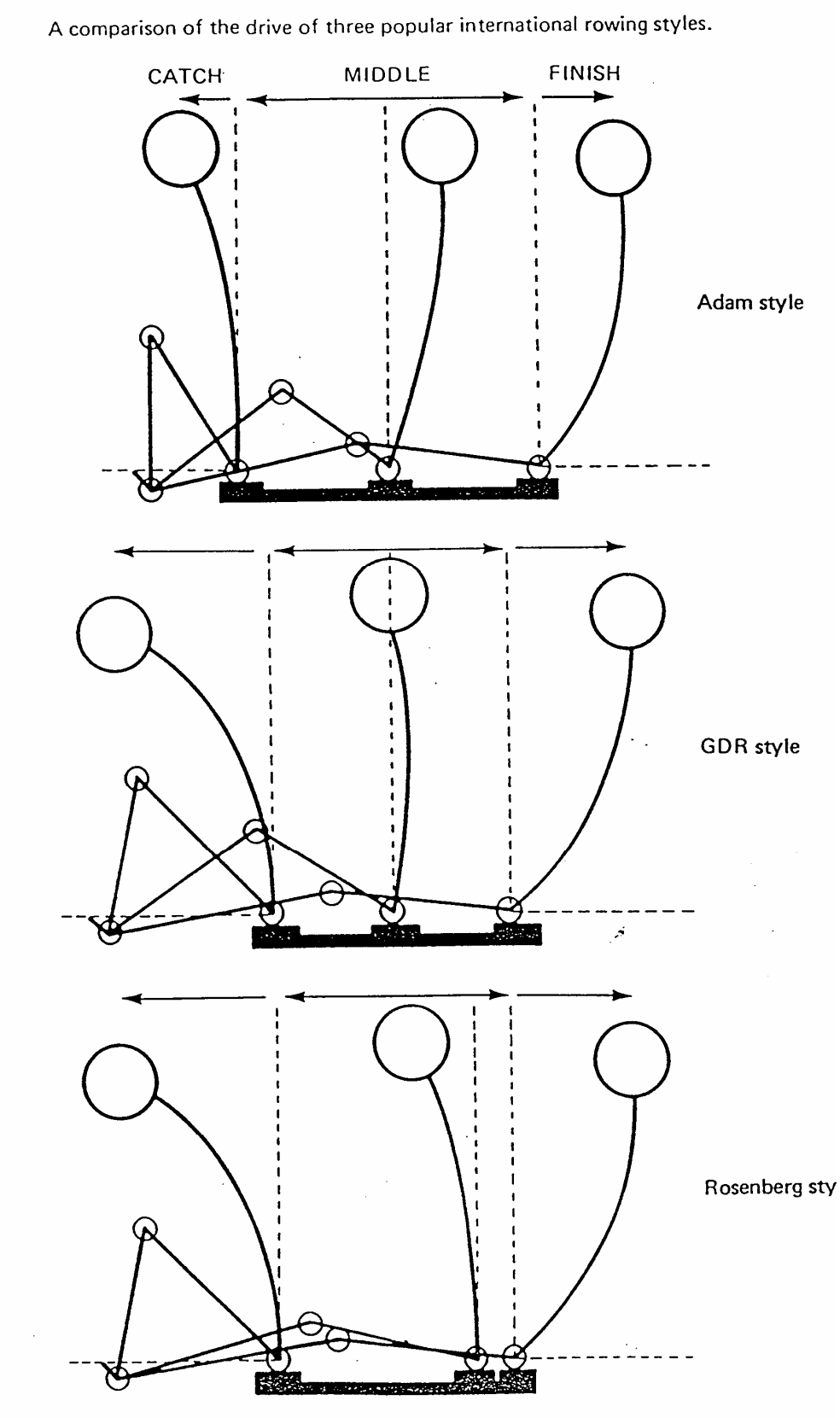



Fig. 3

In spite of this, many medals were won by nations using this technique in the early 1970s.

D. The Orthodox Technique

In the orthodox technique, as exemplified by the GDR on Figure 3, there is less leg compression and more upper body reach. The catch is clearly taken with the legs; the body position at the catch is achieved at the beginning of the recovery by pivoting from the hips off the backstops. The recovery is well controlled with the weight on the feet. Because the legs are not so compressed, there is less fatigue build-up in the leg muscles and the contribution of the back and arms is used sequentially - legs/back/arms. There is more "lie-back" at the finish than in the compressed technique with slight variations.

E. The Reach Technique
On Figure 3 this is referred to as the Rosenberg technique and is typical of USA crews through the 1970s until the present day. It is so named from the American coach, Allan Rosenberg, who coached the USA men's 8+ which won the gold medal at the 1974 World Championships in Lucerne.

Today, however, it is most associated with the Italian technique, which features less leg compression still, with a marked body reach position at the catch which is achieved by good coaching of hip pivot off the backstops to establish the body position for the catch before moving up the slide.

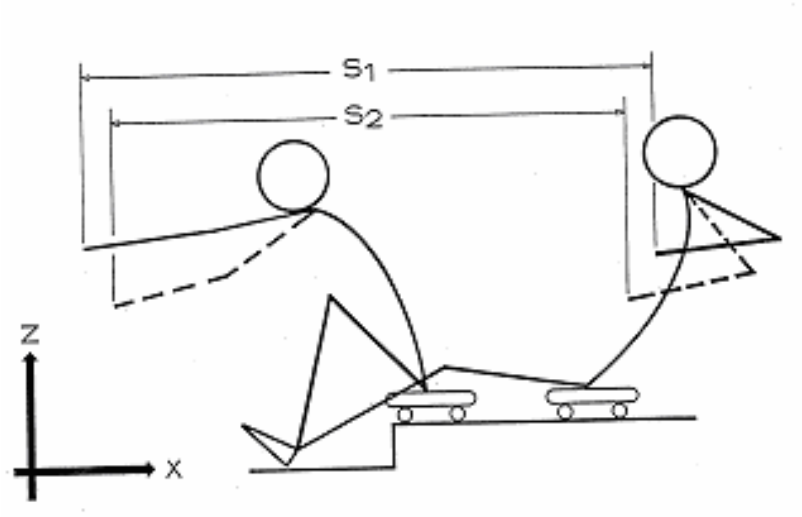
In addition, attention is paid to coaching full "reach" through the arms and shoulders in order to put the shoulder muscles, on full pre-stretch so that the "take-up" through the body, when the fast leg drive is applied to the oar handle, is reduced to a minimum. In this technique, the advantages of the muscle-stretch mechanism are used through the upper body where the muscle fibres are slow-twitch and thus slow fatiguing. Figure 4 shows the typical upper body reach of the Italian technique.

This technique also features a very strong leg drive from a more open knee angle with the body compressed hard against the thighs with full body reach. It should be emphasised that the body at the catch is "reaching" horizontal through the shoulders and not "overswinging" from the hips at the catch whereby the body would collapse and the catch would become more an inefficient upward lift than an efficient horizontal leg drive. Some would say the Italians "shoot their slides" but the important guideline is to compare the speed of acceleration of the oar handle with the speed of the slide.

This technique exploits a strong leg drive to achieve a force peak in the first third of the stroke which is what is ideally required, as we shall discuss later. Finally, there is slightly more "lie-back" at the finish than in the GDR technique.

In summary, most current variations of technique fall within the range of the "orthodox" technique (GDR) and "reach" technique used by the Italians. Relatively speaking, however, this represents a small range of variation compared to the extremes prevalent during the 1970s.

Women's technique also falls within this range.




*2. Higher Riggers - (Figure 5)*

By higher riggers I am actually referring to the height of the "sill" of the swivel above the seat, and this also relates to the heights of the "sill" above the water.

In my opinion, the development towards higher riggers, especially in sculling, offers improved efficiency for a number of reasons:

i. As can be seen from Figure 5, it is possible to achieve a longer stroke because the length of reach of the arms is increased when the arms are more horizontal and assume the same height level as the shoulders.

Equally, the same applies to the length of draw at the finish. Since the body is some 25 degrees past the vertical at the finish and in a slight "C" shape, it is possible to draw longer at a higher level.

ii. With the arms more on the same plane as the shoulders, the contribution of the shoulders and upper body to the first third of the stroke is clearly increased. In addition, the body is in a "stronger" position and, equally as important, the power application is more in the horizontal plane.

iii. The disadvantages, however, are that whilst the finishing draw may be longer, it is also weaker since it is more difficult to achieve a strong arm draw and a "well covered" finish with higher riggers. <u>This applies more to shorter athletes who do not, therefore, sit "tall" in the boat</u> - (some women).

However, in my view, the positive benefits of increased length at the catch and increased power efficiency in the first and second third of the stroke far outweigh this disadvantage. A second disadvantage is that there is less stability and balance control and thus, heights should be increased only gradually as the confidence and proficiency of the athlete increase. High riggers also encourage "dropped" wrists on the recovery in sculling. This applies more to those with weaker wrists (some women) but this problem can be "coached-out" in conjunction with wrist strengthening exercises.

Dropped wrists on the recovery leads to other faults, particularly tight shoulders and a collapsed upper body. In addition, it encourages scullers to reverse their hands on the recovery.

Finally, as with all developments, there are some who have taken this to an extreme, and I consider sculling heights of around 21 cm are too high and are well beyond the optimum for the best technical efficiency. Of course, specific heights must relate to the physique of the individual. I should also mention that in sweep rowing the advantages of higher riggers are less marked since, with two hands on one oar handle, the hands are roughly either side of the centre line of the boat at the orthogonal point. Thus the inside hand - arm - and shoulder will be lower than the outside hand. This asymmetry in rowing means that riggers cannot be as high as in sculling. However, the trend has been in the same direction.

*3. Sculling*

i. Rigger Heights Level

Only if the swivel heights are set level can you achieve symmetry at the catch (entry) and at the finish (release).

If the riggers are set at different heights, scullers are often "out of time" with themselves. In other words, the left and right sculls do not enter and/or leave the water at the same time. You would be amazed how often this is the case. In addition, at the finish, it is more difficult to keep the higher scull "covered." At the extraction also, it is more difficult to extract and push away cleanly with the lower scull.

If the rigger heights are set at different levels, it only encourages scullers to scull with their hands one above the other during the "crossover" phases. If the hands are level at the catch and at the finish, yet above one another during the crossovers, then clearly the boat will "rock" during every stroke. This increases "drag" on the hull and also causes more instability in the boat.

ii. Hands Leading/Following

The debate continues as to whether or not the hands, during the "crossover" should be "above and below" or "leading and following." In GBR we have standardised "leading and following" with the left-hand leading at all times. This is also standardised in FRA and BEL, and most nations (except GDR) have standardised the left-hand lead/on top.

Before we standardised, I observed many thousands of scullers taking part in long distance races in the 1970s. I recorded 70% using the left-hand lead. On this basis, therefore, we standardised this in 1974. In addition, we know that technically the lower hand has a more difficult task because it is trapped under the upper hand. With most people being right-handed, therefore, it is logical to give the harder task to the more dextrous hand. If everyone is taught the same way, there is no problem and, of course, standardisation is essential for crew sculling.

In order to be efficient at the "crossover" during the propulsive phase, the asymmetry can be achieved either by a slight twist in the body and by advancing the right shoulder earlier, or by keeping the body symmetrical and bending the right arm earlier. The best technique uses a combination of these.

Equally, on the recovery, it is essential that the left hand lead after the extraction. If the wrists are dropped on the recovery, then usually the hands become reversed, and this is known in GBR as "knitting." We are assuming the "left-hand lead" technique is such that the right hand comes through first on the draw and the left hand leads away first on the recovery. Thus the hands remain in the same relationship throughout. However, dropped wrists cause the right hand to lead away first on the recovery whilst it is still the underneath hand. In this case, it is very difficult to control the balance on the recovery. Since this aspect of sculling technique is universally taught badly or not taught at all, I will describe the coaching sequence in depth.

At the catch the body and hands should be symmetric. As the "crossover" phase approaches, the RIGHT hand should draw a little earlier to come through first. During the draw phase, balance is entirely with the RIGHT hand and, therefore, the right hand should draw up at the finish to ensure that the boat does not drop down on the right hand side.

At the extraction, the hands should be level but immediately after the extraction the left hand should be coached to lead away faster so that during the recovery "crossover" phase the left hand is leading.

During the recovery, the balance of the boat is entirely controlled by the left hand, which should push down to stop the boat dropping towards the right hand side again. The key coaching points are:

During the propulsive phase:
RIGHT hand draw in first
RIGHT hand draw up during the draw

During the recovery phase:
LEFT hand lead away first
LEFT hand bear down to control balance

On the draw:
RIGHT hand
RIGHT elbow *FIRST*
RIGHT shoulder

On the recovery:
LEFT hand
LEFT elbow *FIRST*
LEFT shoulder

The best exercise to get the hands "right" during the propulsive phase is to try to get the sculler to draw through the crossover so that the right knuckles touch the underneath of the left wrist, i.e., where your watchstrap would be.

This is done only as an exercise and as such, the sculler must "feel" the right knuckles touch the left wrist on every stroke.

During the recovery phase, the fingers of the LEFT hand should be uncurled from the scull handles and straightened. If this is done with dropped wrists, you will lose the scull!!! You, therefore, HAVE to flatten the wrist first so that the scull

handle is balanced under the bridge of the fingers only. The sequence is to flatten the fingers of the left hand only on the grip as normal on the propulsive phase.

It is a natural body phenomenon that if you extend one joint of a limb the other joints in the same limb will also extend. The extension of the fingers, therefore, naturally develops into an extension of the wrist, the elbow and the shoulder. If this is done on the left side only, then a left-hand lead on the recovery will be achieved.

Equally, if dropped wrists on the recovery is a problem, then the exercise can be done with the fingers of BOTH hands being extended during the recovery phase.

Two months of coaching attention to the hands using the coaching points and exercises I have demonstrated, should establish good hand technique at the "crossover" phases, as well as better balance control on the recovery.

iii. Feathering

It seems that feathering the blade on the recovery has gone out of fashion! Notably the Italians hold their blades at a 45 degree angle to the water. The rationale for this is that if the blade is feathered "flat" and happens to touch the water on the recovery, it could get "caught in" on the forward edge and this would cause a "shipwreck." However, if the blade touches the water whilst feathered at 45 degrees it would simply "scuff" the water. Whilst this argument is valid, much more wind resistance is created if the blade is feathered at 45 degrees. In strong winds it is also much harder to control the blades if held at 45 degrees. Finally, to do so means that the scull (or oar) handles have to be gripped in order to be held at a 45 degree angle feather, whereas if they were allowed to rest flat on the sill of the swivel, which still gives 4 degrees from the horizontal (6 degrees with some swivels), the hands can be relaxed on the recovery. Gripping causes a build-up of tension in the forearms which is not to be encouraged.

I recommend feathering the blades flat (4 degrees) on the recovery and do not advocate the current trend in most nations. This applies to rowing equally as to sculling and this is an aspect of efficient technique which women particularly can benefit from at no extra cost.

iv. Body Sequence

We have already discussed the biomechanics of the use of the legs and back in relation to developments in technique in general. I would like to emphasise, however, that the essential difference between rowing and sculling is that the upper body is used a little earlier during the propulsive phase [in sculling]. This is especially required in single sculling since the single is the slowest boat and requires more upper body strength.

b. Whilst the legs initiate the catch and the "drive" phase, the co-ordination of the upper body begins earlier in order to make more use of the back and shoulders in the second phase of the stroke.

c. In addition, the shoulders are used much more than in rowing with the sequence being: legs - back - SHOULDERS - arms, as opposed to legs - back - arms. This difference needs to be brought out in coaching, especially with athletes who have learned to row before they scull.

v. Hip Pivot

In my opinion, the fundamental feature of rowing and sculling technique is the hip pivot as the hands lead away on the recovery.

As a coach, if you can teach this to your athletes, the rest is easy.

It is hard to teach because of the inter-relationship of the quadriceps muscles (knee extensors/hip flexors) and the hamstring muscles (knee flexors/hip extensors). Since both muscle groups work over two joints (knee and hip) with opposing actions, they must be considered together.

The length of the hamstrings are important in respect of the hip pivot at the beginning of the recovery since the knees are held down, the hamstrings are stretched and as you pivot over, the hamstrings are further stretched round the outside of the hip joint. This is why, when you try to touch your toes, you are inclined to bend your knees.

Due to less and less physical education in schools, plus an increasing lack of general exercise caused by the development of the phenomenon known as "the car," children nowadays are far less flexible than before the last world war. Thus the hamstrings particularly are shorter. In sculling and rowing, short hamstrings make it difficult to achieve a good hip pivot off the backstop. Hamstring flexibility should be trained out of the boat by regular flexibility training. It is of major importance in our sport.

I use the term hip pivot rather than body swing off the backstop because it is important to coach the movement from the hips and not achieve it simply by flexing the back. In this way, the body angle for the catch can be established off the backstops without the back "collapsing" on the way forward.

This is actually the hardest and most fundamental aspect or rowing and sculling, and a great deal of time should spent coaching the athlete to master it. Hip pivot is essential to the achievement of a good recovery sequence of hands - body - slide. Time is needed and the emphasis should be: hands - <u>BODY</u> - slide.

vi. The Recovery

The way to achieve time and control on the recovery is to coach for EVEN speed on the slide. A good focus of attention to achieve this is to coach the athlete(s) to try to match the speed of the wheels on the slide to the speed of the boat. When equilibrium is achieved between these two speeds, then you get perfect harmony and the benefit is both relaxation of the body and the best "run" out of the boat during the recovery phase.

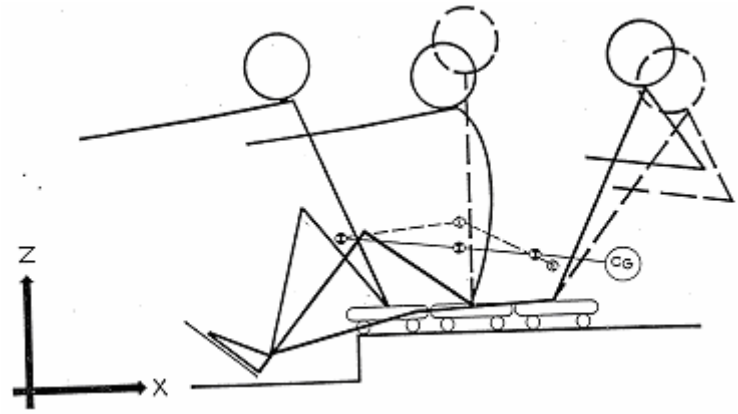
Few coaches relate to the "feel" of the "run" of the boat or the speed of the wheels on the slide (wheels is the key word here) and women particularly respond to attentional focus through the medium of "touch" and "feel."

vii. The Catch

I am not a believer in "bell notes" at the catch or indeed a 'hit" catch. The best way to achieve an efficient "lock-on" to the water without bouncing the boat backwards,

or destroying the run, is to pick up the catch rather like a drive stroke in tennis. In tennis you would never coach someone to hit AT the ball, but rather to drive through it. In the same way, the catch should be almost a squeeze from full stretch. If all the muscles of the arms, shoulders and upper body are on full pre-stretch before the catch, then as the legs drive off the stretcher there will be instantaneous transfer to the blade in the water. Rather like a bow and arrow, the arrow is released when the bow is fully stretched. Scullers and crews who pick up the catch from full reach, and with a large arc forward, can achieve this "driving through" effect rather than just exploding off the stretcher and hitting the catch in an uncoordinated manner which "checks" the boat speed and fatigues the leg muscles sooner.

I consider that efficient technical application of the catch is of particular importance to women or those who are less strong. A longer arc forward, combined with a fast "pre-stretched" catch, can achieve maximum benefit from the first part of the stroke with minimum build-up of lactate.

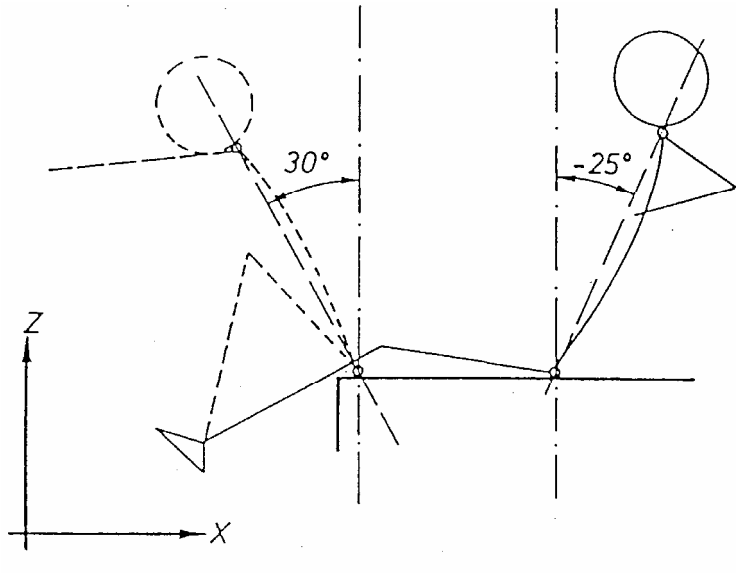



*4. Horizontal Movement of the Centre of Gravity (CG) - (Figures 6-7)*

To return now to the other basic biomechanical principles related to the boat and the body, it is important to reduce the range of horizontal movement of the CG as much as possible.

The figure shows that when using the compressed (Adam) technique the CG moves through a greater range at the catch. In addition, the longer the range of movement, the more difficult it is to control the velocity of movement of the body within the boat. Clearly, movement towards the bow is required in order for the legs to initiate and carry through the drive phase and the need to drive down fast to accelerate the oar handle and thus the boat. However, on the recovery, the velocity of movement up the slide can be controlled as mentioned earlier. In order to "flatten" the speed fluctuation curve (Figure 7) on the recovery phase, it is essential to achieve a "slow" and "even" speed on the slide. The flatter the curve, the less resistance there will be on the hull since resistance increases by the square of the speed such that boat speed acceleration should be kept to a minimum.

These mechanical principles underline the importance of coaching slide control on the recovery as described earlier.




*5. Vertical Movement of the Centre of Gravity (CG) - (Figure 8)*

Movement of the CG in the vertical plane causes the boat to "pitch" fore and aft and this also increases resistance on the hull and decreases boat speed. As can be seen from Figure 8, excessive lie-back at the finish lowers the CG. Peter-Michael Kolbe who has very little lie-back at the finish, and who also displays little body reach forward has one of the lowest vertical movements of CG recorded. This can partly be explained by Figure 9 which shows the range of body swing at the catch and the finish of the singles finalists in the 1981 World Championship in Munich. However, it should be pointed out that they were using sliding rigger boats. The figure does, however, demonstrate the point.

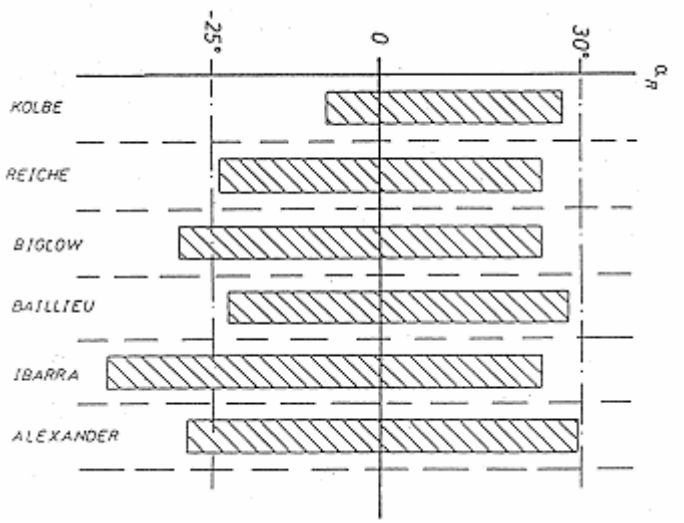



*Fig. 9*

Women are, in general, markedly less strong than men in the upper body and thus tend to lie back further at the finish in order to use upper body weight behind the draw to supplement lack of upper body strength.

It is in this respect, therefore, that coaches of women (if they are weak in the upper body) must compromise between the disadvantages of the lie-back in respect of increased power application to the blades.

In general, the need for "brute force" on the draw has reduced in favour of more endurance since the distance for women has been extended to 2000 m. I would not advocate that technique for all women need to exaggerate the lie-back at the finish, but clearly it may be beneficial for some. Coaches should use their own experience and intuition in this respect after consideration of the individual athletes being coached.

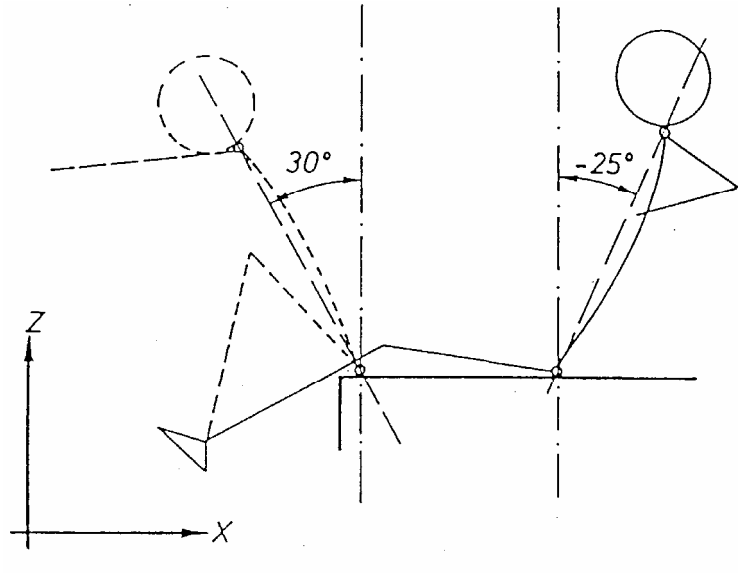



*Fig. 10*

Figure 10 shows the average body angles at the catch and the finish in sculling as:

+30 degree - catch
-25 degree - finish

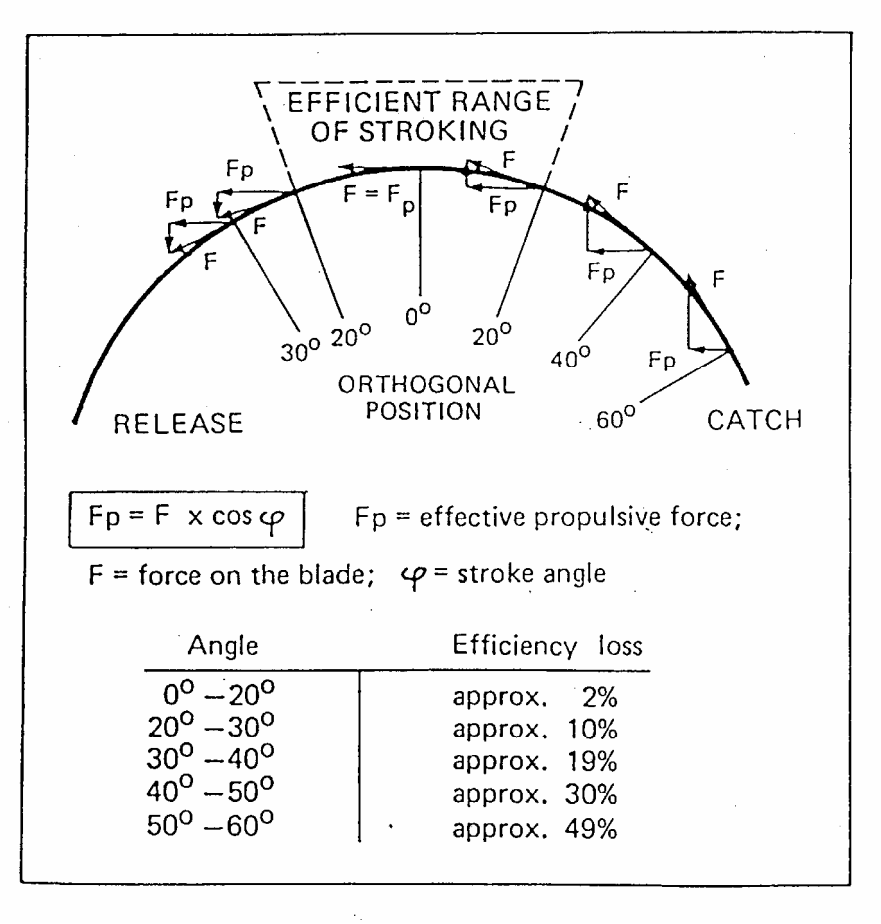
In rowing, in general, there is more body swing at the catch and less at the finish giving probable angles of:

+35 degree - catch
-20 degree - finish

However, I am wary of quoting such averages since so much depends on back flexibility, hip flexibility and limb lengths. Again, coaches should evaluate the individual/crew and coach the most efficient body technique achievable, bearing in mind the limits of the various principles.

### *2.2 Oar Principles - (Figures 11-16)*

During the 1970s and 1980s rigger spreads have changed. In the 1970s arcs became smaller (larger rigger spreads). The rationale for this was that, through the stroke arc, the components of propulsive force reduced either side of the orthogonal (Figure 11). Maximum efficiency was 20° either side of the orthogonal whilst at 50° to 60° either side the loss of efficiency was nearly 50% of that at the orthogonal point.




| Angle | Efficiency loss |
|---|---|
| 0° –20° | approx. 2% |
| 20° –30° | approx. 10% |
| 30° –40° | approx. 19% |
| 40° –50° | approx. 30% |
| 50° –60° | approx. 49% |

*Fig. 11*

In order, therefore, to achieve a long stroke (distance boat moved), whilst using only a shallow arc, rigger spreads were increased and then longer oars were introduced (see Figure 12).

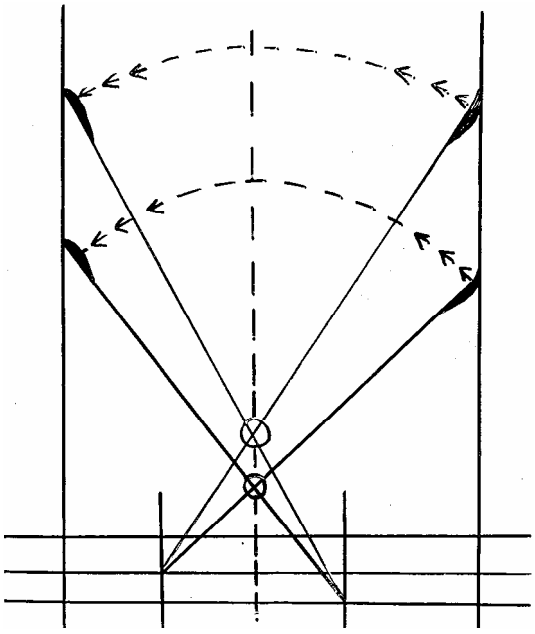


*Fig. 12*

In order to achieve the best results from larger spreads with longer oars/sculls, the rower needs to be very strong and very explosive because the shallower the angle of the pickup at the catch, the faster you have to lock-on to the water. This explosive technique with a smaller stroke arc was also a feature of crews who exaggerated the compressed Adam technique. The necessity to "hit" the catch fast led to early fatigue of the leg muscles and also to "checking" of the run of the boat at the catch.

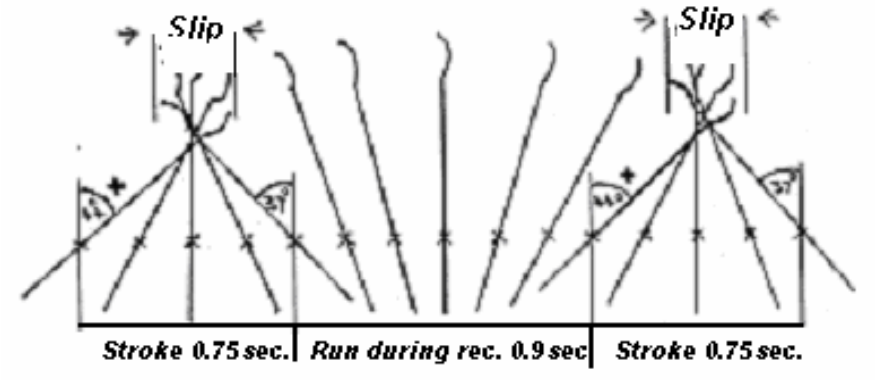



*Fig. 13*

Figure 13 shows the real movement of the blade in relation to the boat. Considered in this way the former argument in respect of the efficiency of the arc angles, is less strong. The boat is moved past the blade rather than the blade past the boat.

Finally, if we imagine that in this figure (13), the boat is also moving forward relative to the water, then this further undermines the arc angles argument.

We must remember that:

- The boat is moving relative to the water.
- The blades are moving relative to the boat.
- Also the athlete's body is moving in relation to the boat.

It is because it is difficult, using figures, to demonstrate the actual mechanics of the boat and the blade relative to the water that the arc angles rationale has been misinterpreted for so long. Now we have video and can also record arc angles and blade force, so we can understand the principles more clearly.

The best way to appreciate the real movement of the blade in relation to the boat and to the water is to analyse video taken from directly above a crew - preferably from a helicopter moving at the same speed.

From above you can see the effect of hydrodynamic lift on the blade at the catch, and the "slip" round the neck of the blade as the blade tip moves away from the boat laterally before the orthogonal and then moves back towards the boat after the orthogonal. (See Figures 13-16)

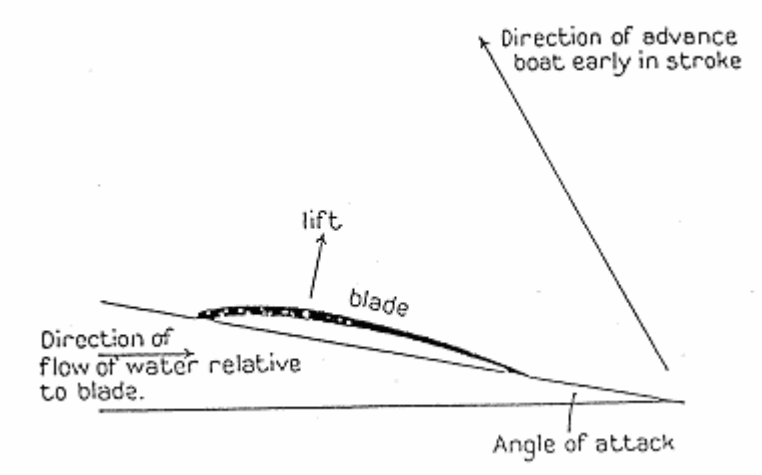
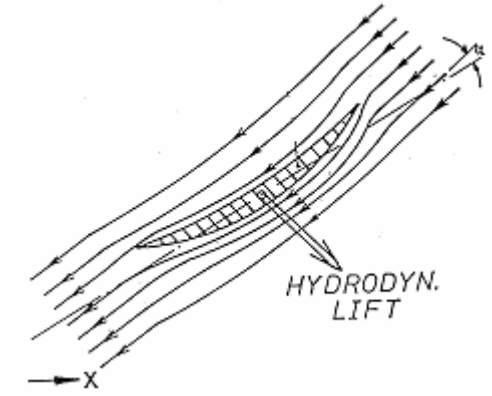



*Fig. 14*

It is interesting to note that Figure 15 was copied from a book entitled *The Way of a Man With a Blade*, which was written in 1957 by the famous British coach "Jumbo" Edwards. So the concept of hydrodynamic lift is not new. However, consideration of its relevance to boat propulsion has been given more consideration in recent years.

To appreciate the effect you should remember that as the blade enters the water at the catch, the boat is moving forward such that the blade actually pierces the water end-on, i.e., the blade is actually pushed into the water tip first by the forward movement of the boat. The greater the arc angle at the catch, the more this is the case. Thus water flows up the blade towards the shaft (Figure 16).



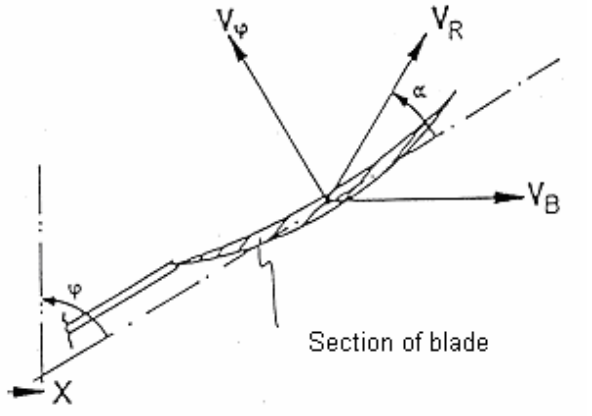




*Fig. 15-16*

Because of the hydrodynamic shape of the blade profile presented to the water, thrust is produced at 90 degrees to the blade.

This is the same principle by which an aircraft takes off. The aeroplane accelerates along the runway and because of the aerodynamic shape of the wings, there is vertical thrust which, above certain ground speeds, causes enough thrust to lift the aeroplane off the ground.

Bearing in mind the effect of both hydrodynamic lift and the fact that the boat is levered past the blade, it is clear that larger arcs forward are not a disadvantage as formerly suggested.

Finally, we should remember that there is a limit to the explosive power of the human being, especially for 5-1/2 minutes or more of effort. Also that a longer stroke with a smoother, wider force:time-curve profile will enable an athlete to propel a boat faster for a longer period of time than a shorter stroke with a higher force:time-curve peak.

The latter requires more explosive power from the athletes, brings on lactate fatigue faster, and causes greater boat speed fluctuations.

Thus, during the 1980s, stroke arcs have increased again, particularly in sculling, and rigger spreads have reduced. The longer oars are, of course, still used by the stronger and taller athletes, but those who are weaker and/or shorter are best advised to use shorter oars/sculls with a narrower spread in order to achieve a larger arc with a manageable work ratio.

Observations of current world class crews confirm the increased efficiency of larger arcs and, as I suggested earlier, length of stroke is the most important principle of boat propulsion.

Women particularly, should therefore, seek to establish a long stroke both by achieving maximum upper body reach at the catch, and by ensuring that the arc size is the first consideration when deciding what spread to use.

Many women are using spreads which are too wide, simply because they are using oars or sculls which are too long. The result is a short stroke, an impact orientated catch, and too much inboard overlap, which has the effect of further shortening the stroke. More on rigging later.

### *2.3 Force:Time-Curves - (Figures 17-21)*

The final consideration of basic principles relates to the force:time-curve (FT) profiles. These vary from individual to individual. They vary with the same individual depending on the rate of striking, the spread of the boat and, therefore, the type of boat as well.

I only have time to consider the fundamental aspects of FT curves as they relate to technique in general rather than as they relate to individuals.

Because we cannot pull on the oar handle unless it is in front of us, and because the leg drive provides the main source of power applied to the handle, it is clear that peak power cannot be achieved at the orthogonal point of the arc. Figure 17 shows a typical FT curve profile and you can see that the peak force occurs well before the

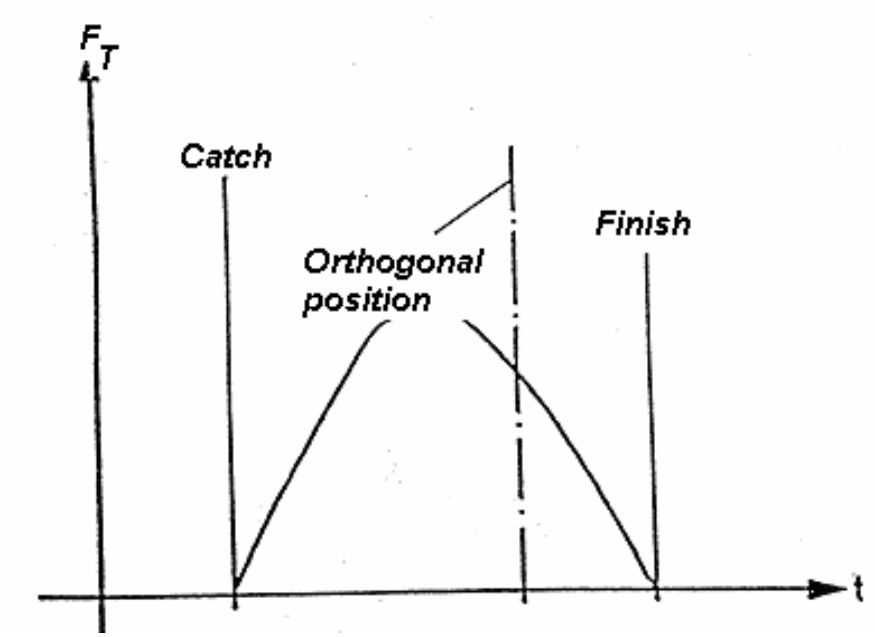



*Fig. 17*

Orthogonal (intermittent line). From Figure 18 we can see that the force peak is in the middle third of the arc but that two thirds of the arc occurs before the Orthogonal. Figure 19 shows an FT curve in relation to the blade and body positions.

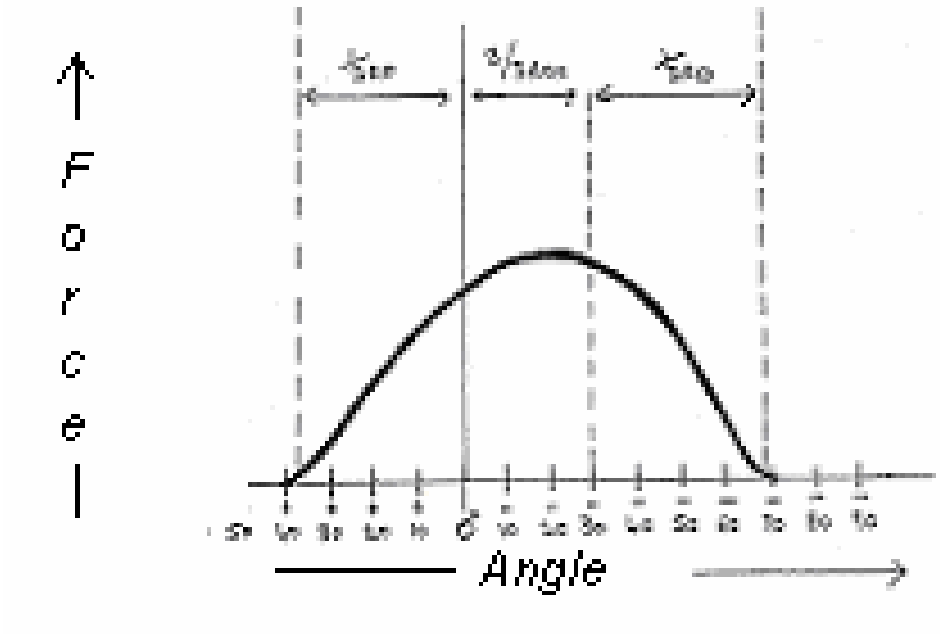



*Fig. 18*

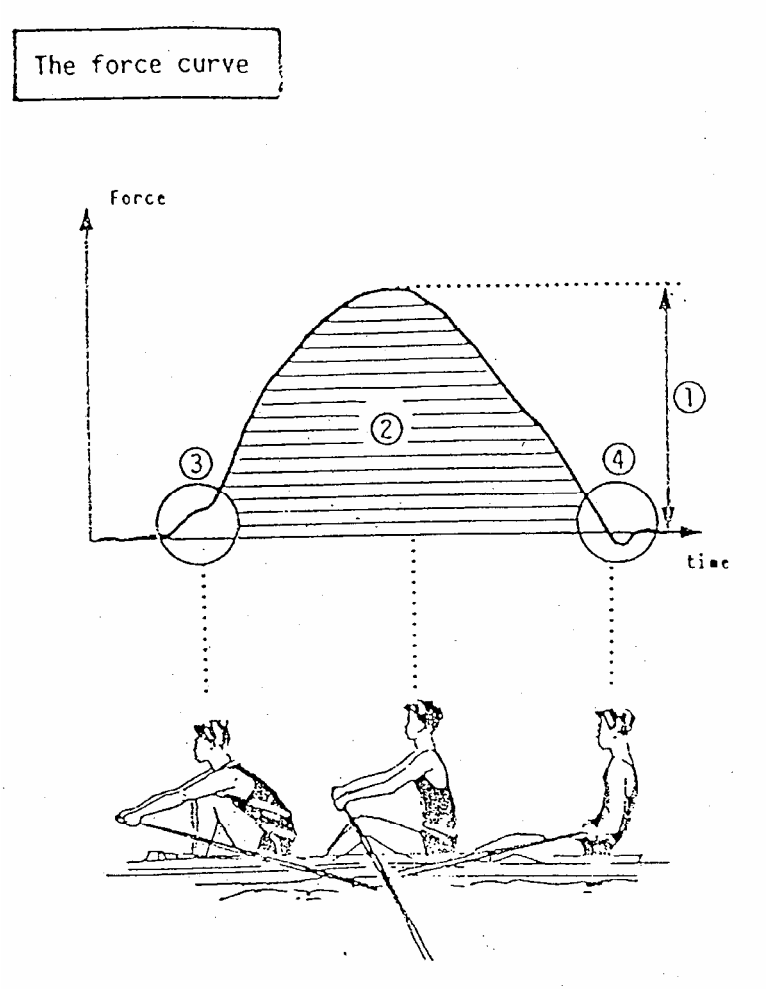



Fig. 19

Figure 20 shows the individual FT curves for the legs (knee angle), back (hip angle) and arms (elbow angle), which better explains why the FT curve peak, is 30-40 degrees before the orthogonal point.

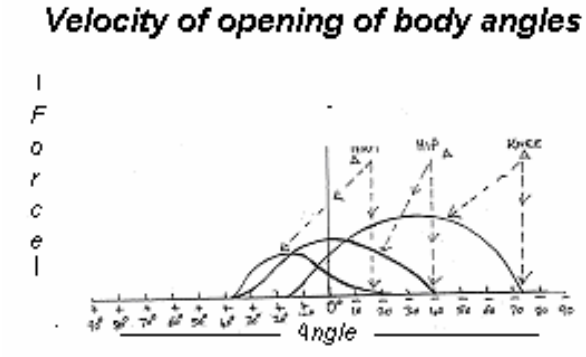



*Fig. 20*

If presented with an individual FT curve, we know that further improvement in power output would be indicated by a larger area of impulse under the curve. If we assume that with improved strength, fitness and technique we could increase the area under the curve, how should we do it? Should we <u>increase the peak force</u> or should we <u>broaden the current shape</u>?

**Without doubt, I would recommend that the current shape should be broadened and maintained for longer.**

In respect of larger stroke arcs, I should emphasise that they have not increased at the finish, and about +37 behind the orthogonal (see Figure 18) is optimal. Since the boat is moving fast through the water, any arc larger than about 40 degrees results in the boat "towing" the blade out of the inside of the puddle such that the blade acts like an inefficient "flipper" being dragged along behind. Clearly this acts as a brake on the boat speed.

In general, at the catch scullers such as Karpinnen can reach -70 degrees from the orthogonal, whereas -60 degrees is the average in sculling. In rowing it is a little less and women seem to be some 10 degrees shorter at the catch than men. This, however, could be changed by rigging.

Consideration of length of stroke, and the method of power applications at the catch, in the light of FT curves further underlines the importance of a longer stroke with larger arc angles at the catch which gives "time" for a smooth, sustained power output over a longer time. Again, this emphasis is more applicable to weaker people who do not have so much latent explosive power. Even with the strongest men, a technique emphasising high peak force with a shorter stroke burns you out very quickly. In addition, hydrodynamically it is not the most efficient way to move a boat.

The data on FT curves, which has accumulated during the 1980s, again endorses the greater efficiency of a long stroke giving time to develop a smooth "full" FT curve. Both the mechanical, biomechanical and physiological data support the fundamental importance of a long stroke.

The table in Figure 21 first published at the FISA Coaches Conference in Athens in January 1991 by Dr. Schwanitz and Dr. Roth (biomechanist and physiologist from the GDR) presents an overview of the mechanical, biomechanical and physiological basis of rowing technique. Analysis of this table could be the basis of a whole weekend of discussion, so I include it here only for your future personal analysis.

### *2.4 Rigging*

It is my contention that many women at both club and international level (especially lightweights) are using inefficient rigs in respect of the following:

- Too large spreads causing too short stroke arcs
- Too long oars/sculls
- Too long oars/sculls INBOARD giving too much overlap

We have already discussed the advantages of a large arc and therefore I will only add some comments on overlap here.

When choosing a rig the priority order is as follows:

1. Decide the spread, which will allow you to scull/row the size of arc you require.

2. Decide the length of the oar/scull OUTBOARD that will give you an appropriate leverage from the size of your arc.
3. Decide the overall length of the oar/scull by adding the INBOARD length required to give you an overlap appropriate to your overall height and particularly your leg length.

i. Overlap

By this, I am referring to the amount by which the inboard overlaps the centre line of the boat at the orthogonal point.

Inboard length has little effect on gearing. It is the outboard length of the oar which is the major leverage factor. This is why we usually quote gearing as spread (minus 2 cm) in relation to outboard. 2 cm are subtracted from the spread (4 cm in sculling) to allow for the difference between the pin (fulcrum) and the inside edge of the swivel against which the oar/scull collar rests. Any length of inboard which overlaps the centre line of the boat, is primarily related to factors other than gearing.

In rowing average overlap is 32 cm. Too long inboard restricts arc length at the catch. Equally, too little causes a weak draw because the outside shoulder, forearm and hand cannot draw directly behind the handle since the end of the handle will swing inside the outside line of the body. This also encourages the outside hand to roll round the end of the handle - then the outside elbow to drop - then the outside shoulder to collapse - and finally the rower to lean out, or away from the rigger at the finish. This reduces further the power of the draw and may also cause balance problems.

Overlap is, therefore, an important dimension to consider and should not be too long or too short. <u>In general, shorter athletes need less overlap.</u>

In sculling also, too much overlap reduces the arc angle at the catch and severely reduces the length of the draw.

The average overlap in sculling is about 22 cm. (The amount by which both scull handles overlap each other.) In the faster moving boats, where more room is needed to extract cleanly and move the hands away quickly, overlap may be less than this. However, overlap is a very individual dimension depending very much on leg-strength.

Tall athletes with long legs need larger overlaps because they have the leg length to "uncross" the overlap as their legs straighten at the finish. Indeed, if they had too little overlap, they would be so far back from the scull handles at the finish that they would simply be pulling the scull handles inboard and the collar away from the swivel.

For shorter athletes, however, and this means many women, this is reversed. If you have shorter legs then you do not have the leg length to "uncross" the overlap at the finish. Many women that I observe sculling have barely 10 cm between their hands at the extraction because their inboard scull lengths are too long and they have too much overlap.

This means that the finish cannot be drawn hard and long, and the sculler's shoulders are "tight" and hunched because she cannot open-up and draw back the shoulders properly at the finish.

This situation occurs because shorter scullers follow the average guidelines for "overlap" and do not realise that overlap needs to be less than average for shorter athletes. Overlaps of 17-19 cm are more appropriate for shorter athletes.

I believe that if many shorter women checked their "set-ups" they would find that probably they would be better with 296 cm sculls instead of 298 cm, the latter being more appropriate for taller scullers on standard overlap.

ii. Women's Rigging Tables - 1988 Olympic Games and World Championships

My second comment in respect of women's rigging is that I believe that many women's crews and single scullers are using spreads, which are too large. This reduces the length of stroke arc and requires a very explosive technique not suited to weaker athletes.

Here are two examples of rig from the 1988 Olympic Games Women's Singles together with the heights and weights of the athletes concerned:

*Table 4: Women's Rigging Tables - 1988 Olympic Games Single Sculls*

| | **Height** | **Weight** | **Spread** | **Sculls** | **Outboard** | **Inboard** | **Overlap** |
|---|---|---|---|---|---|---|---|
| A. | 1.83 m (6'0") | 80+ kg (13+ st or 175+ lbs) | 158 cm | 298 cm | 210.5 cm | 87.5 cm | 21 cm |
| B. | 1.75 m (5'8") | 64 kg (10st or 141 lbs) | 158 cm | 296 cm | 207cm | 89 cm | 24 cm |

Before commenting further, I should point out that these tables cannot be guaranteed as correct and there could well have been misidentification of boat and/or sculls for each athlete. However, the figures are useful as an example.

***Comments:***

1. Athlete A is much taller than athlete B and yet they are on the same spread. With a much shorter reach, therefore, athlete B would have a much shorter stroke arc than athlete A.

2. Athlete B has a much shorter outboard no doubt to give her an easier gearing since she is a lightweight. However, with the same spread and sculls 2 cm shorter overall, she still has very long inboard dimensions because of the short outboards. This gives her an extremely large overlap of 24 cm which will further restrict her length of stroke both at the catch and at the finish. With shorter legs than athlete B the situation is even worse.

3. Does athlete B really need such a short outboard lever? I doubt it, but if she does, should she use even shorter sculls or a larger spread in order to solve the problem? I would not choose a larger spread.

4. Again, it is likely that these dimensions are not correct, but the rigging "set-up" of athlete B is typical of the problem I observe world-wide with the rigging of shorter women.

5. After the women's distance was increased to 2000 m in 1985, I expected a change in women's spreads which would reflect greater endurance efficiency over the longer distance and less orientation towards "brute power" rowing. In other words, I would have expected women to use narrower spreads than previously and thus to use shorter oars/sculls as well.

6. It is interesting that the women (and men) of the GDR have kept their spreads the same throughout the last twenty years with a few exceptions in the single scull to allow for individual extremes. They have remained narrower and we have all observed the very long efficient stroke arcs demonstrated by the GDR women.

7. The questions should be asked: "Is it simply natural conservatism which has kept women's rigging the same for 2000 m as it was for 1000 m?" There is, of course, always a reluctance to experiment, and we know that in our sport it is difficult to measure objectively the results of rigging changes, particularly in the short-term.

However, over the last couple of years, I have seen some signs of change in the direction I would expect. Perhaps the points I have raised today, in conjunction with my appraisal of technique, might stimulate all the coaches here to review their own views on technique and particularly to have a look afresh at the rigging implications for women.

## 3. Summary

### *1. Technique - General*

i. Women need better (more efficient) technique.
ii. Coaches of women should not take technique for granted - teach well and teach methodically.

### *2. Technique - Key Points for Women*

i. Long Stroke Arc
Achieved by:
- Body Technique - Reach through shoulders
- Rigging - Narrower spreads to give larger arcs

ii. Hip Pivot - Basis for teaching technique
iii. Shoulder Reach/Stretch - Essential for an efficient catch
iv. Leg Drive at Catch - Fundamental basis of propulsive phase
v. Lie-Back at Finish - May still be needed by some weaker and/or shorter women
vi. Feathering - If properly taught, it uses no extra energy, so why not feather flat?
vii. Sculling
- Left hand lead
- Hands leading and following
- Body co-ordination - legs - back - SHOULDERS - arms

### *3. Rigging*

i. Riggers Higher - Especially in sculling
ii. Riggers Level - In sculling
iii. Spreads - Are they too large giving a shorter arc?
iv. Oars/Sculls - If spreads were narrower, oars/sculls should be shorter
v. Overlap - Should be less for shorter athletes particularly in sculling

### *4. Recommendations for Women*

Women should endeavour to row/scull larger stroke arcs for the following reasons. A longer stroke:

- Is much more efficient mechanically and biomechanically.
- Requires a less "impact" orientated catch.
- Encourages a larger arc angle forward which makes it easier to pick-up the catch.
- Provides a longer time of stroke during which to develop power.
- Encourages a more even application of power.
- Creates less lactate build-up and, therefore, is less fatiguing throughout the race.
- Creates less boat speed fluctuation and, therefore, less drag on the hull.

# Identification and Correction of Errors

*Contributed by the FISA Competitive Commission*

**General Considerations**

- It is more beneficial to teach proper technique from the beginning than to later correct technique.
- It is important to ensure that the boat is properly adjusted.
- It is necessary to first observe and analyze the action of the blade and boat for a demonstration of the effect of improper technique.
- Next, it is necessary to examine the relative body movements of the athlete to determine the possible causes.
- Determine whether the relative body movement causing the problem is at the point of the demonstrated error or in the preceding phase of the stroke cycle.
- Determine the method to correct the error.
- Explain clearly to the athlete the effect, cause and correction of the error.
- Demonstrate the correct body movement.
- Since beginners may have difficulties correlating the errors to the actual movements of the body, it is better to only show them the correct execution of the movement rather than showing them the incorrect movement.
- Concentrate on one corrected body movement at a time. This is particularly important for beginners.
- Short and frequent training sessions for technique improvement are better than using long and infrequent sessions.
- Since increasing the effective force applied through the oar must be accompanied by an improvement in technique, it is necessary to work continuously on technique correction particularly during periods of increasing training loads.
- Select and use exercises for technique improvement carefully to ensure the maximum benefits.
- Remember, it is important to acquire a good sense of balance and rhythm during the period of learning technique to ensure that the athletes develop the correct perception of the proper rowing technique.

**Sweep Rowing Technique**

**Errors of the Oar**

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 1. The blade is "washing out" at the finish. | The blade leaves the water during the last part of the stroke. Watch from the bow and from the stern. | ♦The outside hand does not pull high enough at the finish. | ♦Stop in the finish position to show the athlete the exact position of the handle at the correct height and with the correct blade depth.<br>♦Pull high in the finish with the outside hand with the elbow high and slightly back.<br>♦Row only with the outside arm.<br>♦Row with square blades. | ♦Pull high with the outside hand and elbow.<br><br>♦Check to make sure the blade is still buried before the extraction. |
| | | ♦Leaning out opposite the oar at the finish. | ♦Keep the body over the center of the boat at the finish. | |
| | | ♦There is too much pitch. | ♦Check the pitch and adjust, if necessary. | |
| | | ♦Oarlock is too high. | ♦Check the height and adjust, if necessary. | |
| 2. Turning the blade under water during the drive. | Water rises up the shaft of the oar before and during the extraction. | ♦The inside hand begins to turn and feather the blade before the extraction. | ♦Row with the blade square, lowering it at the finish with the outside hand.<br>♦Row with the blade square using the outside arm only.<br>♦Row feathering with the inside hand.<br>♦Row normally while concentrating on the finish sequence.<br>♦Row normally controlling the outside lateral pressure. | ♦Do not hold the hands too close or too far apart.<br>♦The inside hand turns the blade to feather.<br>♦The outside hand lowers the handle while still squared, checking that the wrist is still flat before the inside hand feathers the oar.<br>♦For the second exercise, make sure the boat is level.<br>♦For the first and second exercises, concentrate on the outside hand.<br>♦For exercise three, concentrate on the inside hand.<br>♦For exercises four and five, concentrate on both hands. |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 3. Dirty or "splashy" finish. | The water masses and pushes on the convex side of the blade. | ♦Not enough pressure, thus no whirlpools at the finish. | ♦Accelerate the stroke beginning from the entry increasing the pressure to the extraction. | ♦Follow the stroke cycle closely by taking easy strokes. Check the puddles and the fluidity of the drive to see if there is enough strength to release cleanly. Stay well back with the shoulders in the finish. |
| | | ♦The rigging is too long in the finish. | ♦Move the footstretchers toward the stern and check that the end of the handle allows for correct movement by the outside arm. | |
| | | ♦The extraction of the blade is too slow. | ♦Row only with the arms. | |
| | | ♦The riggers are too low. | ♦Check the height of the pull through and adjust, if necessary. | |
| 4. Pulling the collar out of the oarlock during the extraction. | If the foot stretchers are too far to the bow or the rigging is too long in the finish then the athlete tends to pull the oar to the outside in the extraction. | This can be because:<br>♦The outside wrist bends above the grip. | ♦Move the foot stretchers toward the stern in a way that between the end of the tracks at the bow and the perpendicular point from the pin there are 65 cm at maximum. With shorter athletes this measurement becomes smaller. | ♦Look for the athlete to keep a slight amount of pressure toward the oarlock. |
| | | ♦The outside elbow is dropping. | | |
| | | ♦The outside shoulder drops. | | |
| | | ♦The upper body bends to the outside. | | |
| 5. The handle of the oar crosses to the inside of the body at the finish. | The outside wrist lowers itself and turns inside the end of the handle. Check that the handle does not turn to the inside of the profile with the body. Check with the rower stopped at the finish. | ♦The inboard setting on the oar is too short. | ♦Check that the inboard of the oar is 30 to 31 cm more than the spread of the boat. | |
| | | ♦The rigger is too low. There is a tendency to lean to the outside to facilitate the extraction. | ♦Check the height of the oarlock. | |
| | | ♦The rowers lean to the outside to correct the balance. | ♦Look for errors by the crew. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 6. The blade rises or "skies" at the entry. | The blade rises from the water's surface as it approaches the entry. | ♦The hands drop while approaching the entry. | ♦Row with square blades.<br>♦Row normally squaring the blade when the hands pass over the knees in the recovery.<br>♦Row lightly at a low stroke rate with a pause in the recovery at 3/4 slide. | ♦Develop the awareness of the hands and their effect on the blade in each stroke phase.<br>♦Become conscious of the position of the blade relative to the water.<br><br>♦Check that during the exercise before and after the pause the rower doesn't change the level of the recovery. |
| | | ♦The head lowers itself below the chest level and curls up above the feet at the entry. | ♦Take single strokes reminding the rower to focus on one point above the stern.<br>♦Row with no pressure at a low stroke rate keeping the head in line with the spinal cord. | |
| | | ♦The riggers are too low. | ♦Check the height of the riggers and adjust, if necessary. | |
| 7. Slow entry. | The blade takes too long to immerse itself in the water and gather pressure. Check the difference between the time on the recovery and on the drive. | ♦The outside hand moves too slowly at the entry.<br>♦Lack of coordination between the arms and the legs in the timing of the recovery.<br>♦The speed of the slide in the recovery is too fast or is done with flexed arms. | ♦The recovery/entry drill: begin with the exact progression of movements and stop immediately after the blade enters the water. | ♦Check during the recovery for correct and homogeneous succession of movements: extension of the arms and forward lean with the back then slide on the seat. |
| 8. Bow splash by the blade at the entry. | Check the entry of the blade in the water. | ♦A slow entry of the blade in the water. | | ♦Have a firm upper body at the entry. |
| | | ♦Incorrect entry of the blade e.g. the blade goes down in the water then forward. | | |
| | | ♦Not enough pitch. | ♦Check the pitch (more pitch for beginners). | |
| | | ♦Unsure of when to enter. | ♦Teach the correct sequence. | |
| | | ♦Shooting the slide. | ♦Row only with the legs keeping the body and the arms firm in the entry position. | |
| 9. The blade goes too deep at the entry. | The blade enters the water up to the shaft, spraying up towards the bow. | ♦The blade is not completely prepared.<br>♦Not enough pitch.<br>♦The stroke sequence is in error at the entry. | ♦Row normally with full body preparation and speed with the outside hand.<br><br>♦Check the pitch and adjust, if necessary. | ♦Pull on the same plane as the water's surface. |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 10. The stroke is at two speeds. | Check the speed of the oar during the stroke. | ♦Poor coordination among the arms, back and legs. | ♦Row slowly and correctly for a few strokes. | ♦Make the rower sensitive to the constant movement on the slide on the recovery and the increasing pressure during the drive.<br>♦Use a lighter load for beginners. |
| | | ♦The load is too heavy (Not capable of accelerating the stroke). | ♦Check the oar and the rigging to select the correct gearing for the capacity of the rower. | |
| 11. The blade touches the water during the recovery. | Observe the blade during the recovery. | ♦Not enough downward pressure by the outside hand during the recovery. | ♦From a stop, make the oar balance with the hands.<br><br>♦Row with only the outside hand. | ♦Check to see that the blade is not lowered and that it does not touch the water.<br>♦Look to isolate the individual with this error; don't tell the whole crew.<br>♦It is common for juniors to use boats built for heavyweight seniors. |

**Errors of the Hands**

It is very important to identify the role of each hand in the sequence of movements of the hands.

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 1. Hands too close together. | Between one hand and the other there should be about the space of two hands. | ♦The rower was incorrectly taught how to hold the oar. | ♦Practical demonstration<br>♦Show the correct way to hold the handle. | ♦The outside hand should be placed on the end of the oar.<br><br>♦Use tape or string to mark the position of the inside hand. |
| | | ♦The inboard is too short. | ♦Check that the inboard is approximately 30-31 cm longer than the spread. | |
| | | ♦Footstretchers are too close together. | ♦Check and readjust the footstretchers, if necessary. | |
| 2. Hands are too far apart. | | ♦The rower was taught incorrectly how to hold the oar. | ♦Practical demonstration. | |
| | | ♦Inboard is too long. | ♦Don't set the inboard length to be more than 30-31 cm greater than the spread. | |
| | | ♦Footstretchers are too far apart. | ♦Check the width and readjust, if necessary. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 3. The outside hand bends around the end of the handle. | The elbow angles down at the finish. | ♦The inboard is too short. | ♦While sitting at the finish, check the position of the handle with respect to the body. Watch exercises relative to errors of the blade numbers 3 and 4. Row normally. | ♦Pull the elbows behind the plane of the body and not so far that they are sticking out. |
| | | ♦The footstretchers are too close together. | ♦Check and readjust the footstretchers, if necessary. | |
| | | ♦Bending outside of the rigger in the finish because of insecurity in the set. | ♦At the finish, keep pressure against the oarlock. Pull correctly on the oar in line with the length of the boat. | |
| | | ♦Pulling too hard with the outside shoulder. | ♦Complete the pull-through correctly with the arms and not exaggerated shoulders. | |
| 4. Feathering or turning the oar with the outside hand during the extraction. | Watch the blade and the outside wrist while the blade leaves the water. | ♦The rower was taught incorrectly how to execute the release. | ♦Stop the boat with the rowers sitting at the finish. Have them raise and lower the blade in and out of the water while squared. | ♦The outside hand is responsible for controlling the entry and the extraction of the blade and not to feather or square. |
| | | | ♦Row with the blade squared (without feathering). | ♦The outside wrist should remain straight and flat. |
| 5. Squaring (preparing the blade) with the outside hand. | The outside wrist rotates up before the entry. Check the tension of the forearm. | ♦The outside hand squeezes the handle and rotates it. | ♦With the boat still, oars flat above the water in equilibrium, square and feather the oars with the inside hand. The oar rotates within the outside hand. The outside hand serves only to balance the boat at this point. | ♦The outside hand stays loose to permit the oar to turn inside it, while the inside hand turns the handle. The outside wrist remains flat. |
| 6. Arms bent during the drive. | Watch the arms immediately after the entry. | ♦Not enough pitch. | ♦Check the pitch and increase it, if necessary. | ♦Pay particular attention to the extension of the outside arm because it must extend further, and therefore it must travel at a greater velocity. |
| | | ♦Insufficient use of the legs. | ♦Row only with the legs, with the upper body and the arms, fixed in the entry position. 2. Row long distances continuing to relax the arms. | |
| | | ♦Recovery is performed with the arms bent. | ♦Extend the arms immediately after the push down and away with the hands.<br>♦Emphasize length at the entry. | |
| | | ♦Tension and squeezing the handle at the entry. | ♦Carry the handle at the entry with the fingers relaxed. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 7. Inside arm tense at the entry and during the drive. | Watch with care. | ♦Not enough rotation of the shoulders to follow the arc described by the handle.<br>♦Inside shoulder raised. | ♦Row at an easy pace, without pressure. | ♦The shoulders must remain parallel to the handle. The legs and the back move along the axis of the boat, but the shoulders must follow the arc of the handle and therefore rotate above the torso. |
| 8. The handle is too thin. The hands squeeze the handle. | Check for tension in the forearms and of the knuckles. | ♦An insufficient sense of balance in the boat. | ♦See "Errors of the Boat."<br>♦Wiggling the fingers or "Play the piano" during the recovery. | ♦Encourage the relaxation of the grip in both hands. Note: The little finger of the outside hand must remain above the end of the handle and together with the other fingers. |
| 9. Thumb(s) on top of the handle. | Watch carefully for the thumbs on the handle. | ♦The rower was taught incorrectly. | ♦Demonstrate how to hold the thumbs correctly.<br>♦The thumb of the outside hand must stay below to help maintain complete control of the oar. | ♦Both thumbs must stay under the handle. The thumb of the inside hand must stay below the handle to retain the grip needed to feather and square the oar. |

**Errors of the Body**

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 1. "Shooting the slide" or lack of connection between the leg drive with the upper body drive. | Put yourself beside and focus your attention on the movement of the body with respect to the seat. | ♦Extra forward reach with the upper body in the last part of the recovery. | ♦Check the height of the footstretchers and adjust, if necessary. | |
| | | ♦Lack of coordination between the legs and the body. | ♦Row with acceleration concentrating on the isometric tension of the body at the beginning of the leg drive. | |
| | | ♦The back is not strong enough to handle the drive of the legs. | ♦Exercises appropriate to improve the strength and coordination of the back.<br>♦Row only with the legs, with the back and arms fixed in the entry position. | |
| | | ♦Too much load on the oar for the body to handle. | ♦Check the inboard and spread (especially for young people). | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 2. Falling toward the opposite side of the rigger at the entry. | Check from behind that the outside shoulder drops and moves outward with respect to the center of the boat. The inside shoulder rises. Also, the inside arm is not bent. | ♦The athlete feels insecure to follow the handle.<br>♦Lack of balance in the boat. | ♦Row only with the outside arm.<br>♦Row easily with the shoulders parallel to the handle. | ♦Rowing only with the outside arm holding the inside hand behind the lower back. |
| 3. Extra reach at the entry - the upper body droops at the entry. | Check the position of the body at the entry. | ♦Footstretchers are too low. | ♦Check the height of the footstretchers and adjust, if necessary. | ♦Maintain the correct position with the back at the entry. Correctly prepare the arms and back before sliding forward during the recovery. |
| | | ♦Tendency to over-reach at the entry. | ♦Do the 2 stop drill. Row with a stop at the extension of the arms and a stop when the back is angled forward (the position when the arms and the back are ready for the entry). | |
| | | ♦Insufficient preparation of the arms and back before starting to slide forward on the seat. | ♦The same 2 stop drill will help here also. | |
| 4. At the finish, the upper body leans on the handle or the shoulders "fall" over the handle. | Look to see if the upper body is pulled forward over the handle. | ♦The pull of the arms begins too soon before the shoulders pass the vertical. | ♦Use the weight of the upper body to augment the power of the drive in the water, particularly pulling well back with the outside shoulder. | ♦Check that the shoulders stay well behind the handle during the extraction of the blade. Check that the hands and arms extend out well before the upper body leans forward during the recovery. Double check the drive as it approaches the finish. The center of gravity must stay behind the seat. Check that the oar is pulled in toward the body and not the opposite. |
| | | ♦Problems with the finish. | ♦Row with the blade square. | |
| 5. Upper body hanging out over the gunwale at the finish. | See "Errors of the Hands" No. 5. | ♦Footstretchers are too far towards the bow. | ♦Row checking on the rotation of the upper body. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 6. Lying back too far at the finish. | Look at the shoulders with respect to the seat and the position of the spinal column. | ♦Lack of coordination between the upper body and the arms in the transmission of the upper body on the blade. Closing the pull-through of the arms too late with respect to the finish of the action of the upper body. | ♦Row easily at a low stroke rate.<br>♦Check the complete movement | ♦During the second part of the drive, maintain the action of the upper body behind the oar with the immediate transmission on the oar. |
| | | ♦Rigging is too low. | ♦Check the height of the riggers. | |
| 8. Uneven drive with the legs. | The outside leg pushes and finishes before the inside leg. The knee rises at the finish. Can cause the boat to be down to the side opposite of the rower making the error. | | ♦Row at an easy pace, emphasizing equal pressure on the footstretchers, particularly at the beginning of the drive. | ♦Check the perception of an equal drive of the legs during a stroke. |
| 9. Lack of slide control during the recovery. | Check the speed of the sliding seat during the recovery. | ♦Loss of the correct sequence (hands, body, slide) after the extraction. | ♦Row at a low stroke rate.<br>♦Row single strokes taking time to ensure a correct sequence of movements. | ♦The run of the boat must be disturbed as little as possible. |
| | | ♦Travelling too fast on the slide. | ♦Row at a low stroke rate checking that the upper body is assuming the correct position at the finish and during the first part of the drive. | |

**Errors of the Crew**

- With the awareness that the lack of rhythm and balance in the boat can provoke individuals to make new errors, the coach can appreciate the value of beginning with correct instruction of beginners in a single scull.
- The beginner in a single must learn the correct technique while receiving the response of the boat directly. Learning in a crew boat with other beginners creates many more problems because the responses of the boat are cancelled or modified by the other rowers in the boat.
- In a crew boat the process of learning the technique is much slower and it increases the risk of acquiring movements that compensate for other errors.
- In theory, the technique must be learned individually, and only when an athlete is sufficiently experienced is it practical to row with others. When, in a crew boat, every pair of rowers can row at full slide feathering, then the crew can train like a complete unit. At this point, the attention of the coach must be devoted to the rhythm and the balance, and particularly to the timing of the finish.
- The exercises that allow for a "stop" at a precise point in the stroke cycle permits us to check that all of the rowers in a crew find the correct position at the same time.

**Conclusions**

Follow this list of drills utilized with the technical benefit correlated to every benefit if used with correct instruction. The requirement is to teach and have the rower learn the best technique.

- Describe the movement with clear, simple and concise terminology.

- Demonstrate with gestures to the rowers what must to be repeated.

| Exercise | Technical Benefits | Possible Problems Derived From Abuse |
|---|---|---|
| 1. Rowing with a square blade | · quick extraction<br>· powerful finish<br>· prevents lowering the wrists<br>· aids balance and self-confidence | · squeezing the handle during the recovery<br>· it can be boring training |
| 2. Single strokes | · controls the balance<br>· allows you to clearly see the course of the boat<br>· it takes time to prepare the movement on the recovery<br>· check the height of the hands ~ aids in balance and self-confidence | · lose the rhythm of the stroke cycle<br>· more difficult to balance |
| 3. Row with the eyes closed | · helps to perceive the exact sensation of rhythm and time<br>· helps to relax and facilitate balance<br>· the athlete can fix the imagination for developing a particular technique, for example the control of the position of the blade at the entry | |
| 4. Rowing at 1/4,1/2, and 3/4 slide | · quick entry<br>· acceleration of the power applied by the legs that increase proportionally with the slide<br>· awareness of the length and the opportunity to row with strokes sufficiently long<br>· conducive to learning the correct technique from the start | · lack of precision in the speed of the slide at the entry<br>· can accustom the upper body to raising at the entry |
| 5. Stop at the finish | · awareness of the position and height of the hands at the finish<br>· distance of the hands from the body at the finish<br>· power in the finish observing the puddles or whirlpools that race away | · encourages feathering under water<br>· discourages a harmonious release |
| 6. Row at a low stroke rate (16-18 strokes per minute) for brief periods | · perception of the acceleration of the power application<br>· perception of the course of the boat in the drive and in the recovery<br>· check on the correct recovery. | · strokes at a resistance twice the normal<br>· stiffening of the muscles |

| Exercise | Technical Benefits | Possible Problems Derived From Abuse |
|---|---|---|
| 7. Row with only the outside arm (with square blades). The inside hand is held behind the lower back. | · identifies the role of the outside hand in controlling the blade and the balance<br>· corrects the tendency to raise the blade too high before the entry<br>· stimulates the rotation of the upper body<br>· improves the movement at the entry | · can provoke too firm a grip on the handle and a stiffening of the arms<br>· can cause balance and rhythm problems |
| 8. "Playing the piano" | · discourages an excessively tight grip<br>· stimulates rotation of the upper body<br>· improves the movement at the entry | · can encourage a grip that is too loose<br>· lose the identification of the role of each hand |
| 9. Row with no slide and without the back (arms only) at a high stroke rate | · speed of movement of the hands in the entry and the finish | · shortens the entry<br>· loss of the coordination between the movement speed of the hands and that of the upper body |
| 10. Row with no slide using the back and arms | · correct the succession of movement of the hands and upper body in the finish | · the blade can rise too high above the water<br>· taking the entry raising the shoulders<br>· breaking off the rhythm |

Note: In these exercises it is useful to alternate the fixed blade and feathering. In all the cases, it is important to emphasize experimenting - on the part of the coach and the rower - of the concentration perceived motor learning for the exact execution of exercises toward the objective.

## Sculling Technique

### Errors of the Oar

1. The most errors in sculling are found in the action of the blade and it is in this aspect of the movement that the coach must concentrate most of his or her attention.
2. We will list the common errors, their causes and how to correct them.

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 1. The blade is "washing out" at the finish. | The blade leaves the water during the last part of the stroke. Watch from the bow and from the stern. | ♦The pull through is not high enough in the finish (the hands pull through below the rib cage). | ♦On light pressure, watch closely that the blades carry the full pressure and the handles follow through to the ribs. Progressively increase the pressure of the stroke. | ♦Pull the handles in high.<br>♦Keep the blade buried.<br>♦Finish the drive with the wrists at the same level.<br>♦Check the level of the boat at the release.<br>♦Ask the rower to memorize the exact position of the moment of the pause. |
| | | ♦The elbows finish the pull through lower than the wrists. | ♦Row only with the arms, upper body firm in the finish position, stopping every three strokes, for an instant, with the elbows in the correct finish position. | |
| | | ♦Too much pitch. | ♦Check the pitch. | |
| | | ♦Oarlocks are too high. | ♦Check the height. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 2. Turning of the blade under water. | Water rises up the shafts of the sculls during the extraction. | ♦The sequence of movements of the wrists in the extraction is incorrect. | ♦Row with square blades | |
| | | ♦The grip on the sculls is too tight. | ♦The last part of the drive is ineffective if the hands are over gripping and the wrists are rolled up or squeezing too hard. | |
| 3. Dirty or "splashy" finish. | The water masses and pushes on the convex side of the blade. | ♦Not enough pressure, thus no whirlpools at the finish. | ♦Accelerate the stroke beginning from the entry increasing the pressure to the extraction. | ♦Follow the stroke cycle closely by taking easy strokes. Check the puddles and the fluidly of the drive to see if there is enough strength to release cleanly. Stay well back with the shoulders in the finish. |
| | | ♦The extraction of the blade is too slow. | ♦Row only with the arms. | |
| | | ♦The rigging is too long. | ♦Move the foot stretchers toward the stem and check that the ends of the handles contact the ribs at the release. | |
| 4. A blade comes out before the other. | Watch the action of both the blades from the bow and from the stern. The boat drops toward the side of the scull that is last out of the water. | ♦The crossover of the grips is staggered. | ♦Row normally while checking that the crossover of the hands during the recovery and during the drive - the right hand should be below the left hand at the perpendicular to the rigger. | ♦End the pull through and begin the recovery with the hands at the same levels.<br>♦Check that the boat is moving in a straight line.<br>♦Emphasize the correct movement of the hands in the push down and turn at the finish.<br>♦Be sure that there is the correct amount of pressure between the hands and the feet. |
| | | ♦The pull through is not level. | ♦Row without pressure at a low stroke rate. | |
| | | ♦One hand drops before the other. | ♦Row without pressure at a low stroke rate. | |
| | | ♦The riggers are not set at the correct heights. | ♦Check the height of the riggers. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 5. The blades rise at the entry. | The blades rise from the water's surface as they approach the entry. | ♦The hands drop while approaching the entry. | ♦Row lightly at a low stroke rate with a pause in the recovery at 3/4 slide. | ♦Check that during the exercise before and after the pause doesn't change the level of the recovery. Raise the hands at the moment of the entry.<br>♦Learn to perceive, before the entry, where the blades are relative to the water.<br>♦Observe the sculls during the drive and look for the position of the blade relative to the water<br>♦Develop the concept of the hands and of the blade in the phase.<br>♦Become conscious of the position of the blade relative to the water. |
| | | ♦The hands hold the sculls too tightly. | ♦Train the fingers while moving toward the stern.<br>♦"Play the piano" with the fingers. | |
| | | ♦The head lowers itself below the chest that it curls up above the feet at the entry. | ♦Take single strokes reminding the rower to focus on one point above the stern.<br>♦Row with no pressure at a low stroke rate keeping the head in line with the spinal cord. | |
| | | ♦The riggers are too low. | ♦Check the height of the riggers. | |
| 6. Slow entry. | The blade takes too long to immerse itself in the water and gather pressure. Check the difference between the time on the recovery and on the drive. | ♦The hands move too slowly at the attack.<br>♦Lack of coordination between the arms and the legs in the timing of the recovery.<br>♦The speed of the slide in the recovery is too fast and/or the arms are flexed. | ♦The recovery/entry drill: begin with the exact progression of movements and stop immediately after the blade enters the water. | ♦Check during the recovery for correct and homogeneous succession of movements: extension of the arms - forward lean with the back - slide on the seat. |
| 7. Bow splash by the blades at the entry. | Check the entry of the blades into the water. | ♦A slow entry of the blades into the water. | | ♦Set the upper body in the recovery and keep it firm at the entry. |
| | | ♦Incorrect entry of the blade (e.g., down then forward). | | |
| | | ♦Not enough pitch. | ♦Check the pitch (more pitch for beginners). | |
| | | ♦Unsure of when to enter. | ♦Teach the correct sequence. | |
| | | ♦Shooting the slide. | ♦Row only with the legs with the body and the arms firm in the entry position. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 8. One blade enters the water before the other. | Watch the action of both the blades from the bow and also from the stern. The boat drops toward the side of the scull that enters the water first. | ♦One hand rises at the entry before the other. | ♦Row easily at a low stroke rate. | ♦Check to see that the boat is balanced. |
| | | ♦The shoulders are not at an equal height at the entry. | ♦The recovery/entry drill: begin with the exact progression of movements and stop immediately after the blade enters the water. | |
| | | ♦The riggers are not set at the correct heights. | ♦Check the height of the riggers. | |
| 9. The blades go too deep at the entry. | The blades enter spraying towards the bow at the entry. | ♦The blades are not completely prepared. | ♦Row normally with a full preparation and speed with the outside hand. | ♦Pull on the handles at the same plane as the water's surface. |
| | | ♦Not enough pitch. | ♦Check the pitch. | |
| | | ♦The stroke sequence is in error at the entry. | | |
| 10. The blades touch the water during the recovery. | Look at the blades. | ♦Not enough downward push by the hands. | ♦From a stop, make the sculls balance with the hands.<br>♦Row with only the outside hand. | ♦Check to see that a blade is not lowered and touches the water.<br>♦Check the size of the boat because it is common far children to use boats built for adults. |

**Errors of the Hands**

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 1. The handles finish the pull through at the sides of the rower. | Check the positions of the wrists that they drop and rise too much. | ♦The footstretchers are placed too far toward the bow. | ♦Check the position of the footstretchers in respect to the position of the hands in the finish. | ♦Treat the movement of the second part of the drive. |
| | | ♦The push of the legs is not complete in the finish. | | |
| | | ♦The inboard on the sculls is not enough. | ♦Check at the crossover of the handles that there is approximately 18-22 cm. | |
| 2. The wrists bend at the finish. | Watch the finish very closely. | ♦Not allowing the handles of the sculls to be rotated by the fingers. | ♦Exercises to rotate the handles with the fingers.<br>♦Conclude the finish well with the fingers forward.<br>♦Row with square blades. | ♦It can be caused by turning the sculls while still in the water.<br>♦Emphasize the importance of continuing the movement of rotation in the release. |
| | | ♦The rigging is set too long which renders the extraction difficult. | ♦Check that the footstretchers are not too close together.<br>♦Check that the inboard is set correctly. | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 3. The wrists | Observe by looking | ♦Wrists were bent in the finish. | ♦As above. | |

| | | | | |
|---|---|---|---|---|
| are bent during the recovery. | very closely. | ♦The load of the inboard and span is too heavy for the rower. | ♦Check the correctness of the inboard and the span. | |
| 4. Grip on the oar is too tight. | Look at the tension in the forearms. | ♦Gripping the handle with the palm of the hand. | ♦Try the exercise "playing the piano."<br>♦Teach the correct position rowing easily with the blades squared. | ♦Relax the hold on the handle, especially during the recovery.<br>♦Lateral contact with the thumb and hand hooked around the handle. |
| | | ♦Tension in the forearm. | ♦Row holding with the fingers. | |
| | | ♦The pitch is not correct. | ♦Check and adjust the pitch, if necessary. | |
| 5. Elbows that bend too soon causing the rower to grasp onto the grips. | Observe immediately after the entry; look individually at each elbow. | ♦Not enough pitch on the sculls. | ♦Check and increase the pitch, if necessary. | ♦Sensitize the rower to the correct succession of the intervention of the three motors of the drive: the legs, the back and the arms. |
| | | ♦Insufficient use of the legs at the beginning of the drive and the back during the pull through. | ♦Row easily for long distances maintaining the arms relaxed. | |
| | | ♦Recovery with the arms bent. | ♦Begin the recovery from the finish position by first extending the arms straight forward. | |
| | | ♦Tension squeezing the handles during the recovery. | ♦Arrive at the entry during the recovery with the fingers extended and relaxed. | |

**Errors of the Body**

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 1. "Shooting the slide." | Put yourself beside and focus your attention on the movement of the body with respect to the seat. | ♦Extra forward reach with the upper body in the last part of the recovery. | ♦Check the height of the footstretchers. | |
| | | ♦Lack of coordination between the legs and the body. | ♦Row with acceleration concentrating on the isometric tension of the body in the first part of the stroke at the beginning of the leg drive. | |
| | | ♦The back is not strong enough with respect to the drive of the legs. | ♦Exercises appropriate to improve the strength and coordination of the back.<br>♦Row only with the legs, with the back and arms in the entry position. | |
| | | ♦Too much load on the oar and rigger. | ♦Check the inboard and spread (especially for young people). | |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 2. Uneven drive with the legs. | Check that both the knees go down at the same time during the drive. | ♦Unequal pull with the arms or push with the legs. | ♦Row at an easy pace emphasizing equal pressure on the footstretchers. | ♦Carefully check for equal distribution of pressure on the footstretchers, equal push of the legs, equal drive with the back and the arms. |
| 3. Lying back too far at the finish. | Look for the shoulders with respect to the seat and at the position of the vertebrae column. | ♦Lack of coordination between the upper body and the arms in the transmission of the upper body on the blade. Close the pull-through of the arms too late with respect to the finish of the action of the upper body. | ♦Row easily at a low stroke rate.<br>♦Check the complete movement. | ♦During the second part of the drive, maintain the action of the upper body behind the oars with the immediate transmission on the oars themselves.<br>♦Don't lie back too far at the finish. |
| | | ♦Attempting to lengthen the stroke beyond the relevant sector. | ♦Row single strokes stopping at the finish to perceive the correct position (don't use this exercise too much). | |
| 4. The upper body leans over the handles or the shoulders "fall" over the handles at the finish. | Look to see if the upper body is pulling forward over the handles of vice versa. | ♦The pull of the arms begins too soon before the shoulders pass the vertical. | ♦Use the weight of the upper body to augment the power of the drive in the water.<br>♦Row with the blades squared. | ♦Check that the shoulders stay well behind the handles during the extraction of the blades.<br>♦Check that the hands and arms extend out well before the upper body leans forward on the recovery.<br>♦Double-check the drive when approaching the finish. The center of gravity must stay behind the seat. |
| 5. Extra reach at the entry - the upper body falls forward at the entry. | Check the position of the upper body at the entry. | ♦Footstretchers too low. | ♦Check the height of the footstretchers. | |
| | | ♦Tendency to over-reach at the entry. | ♦Do the 2 stop drill. Row with a stop at the extension of the arms and a stop when the arms are extended and the back is forward (ready for the entry) and then complete the slide. | ♦Maintain the correct position with the back at the entry. |
| | | ♦Insufficient preparation of the arms and back before starting to slide forward on the seat. | ♦The same 2 stop drill will help here also. | ♦Correctly prepare the arms and back before sliding forward into the recovery. |

| Errors | Technical Explanation | Causes | Drills and things to look for | Points to Teach |
|---|---|---|---|---|
| 6. Lack of control of the slide during the recovery. | Check the speed of the sliding seat in the recovery. | ♦Loss of the correct sequence (hands, body, slide) during the recovery. | ♦Row at a low stroke rate. | ♦The run of the boat must be disturbed as little as possible. |
| | | ♦Travelling too fast on the slide. | ♦Row single strokes taking time to insure a correct sequence of movements. | |
| | | ♦Unable to accelerate the drive. | ♦Row at a low stroke rate, checking that the correct position of the upper body is assumed at the finish and during the first part of the stroke. | |

## Conclusions

Follow the list of exercises/drills utilized with the technical benefit correlated to every drill if used with correct instruction. The requirement to teach and learn the best technique.

- Describe the movement with clear, simple and concise terminology.
- Demonstrate with gestures to the rowers that which tends to be repeated.

## Errors of the Crew

- The awareness that the lack of rhythm and of balance of the boat can cause errors adapted to individuals makes the coach appreciate the value of a correct instruction of the beginners in a single.
- The beginner in a single must learn the technique receiving the response directly from the boat. Learning in a crew boat with other beginners creates many more problems because the responses of the boat ate cancelled or modified by the other rowers in the boat.
- In a crew boat the process of learning the technique is much slower and it increases the risk of acquiring movements that compensate for other errors.
- In theory, the technique must be learned individually, and only when an athlete is sufficiently experienced is it practical to row with others. When in a crew boat every pair of rowers can row at full slide feathering, then the crew can train like a complete unit. At this point, the attention of the coach must be devoted to the rhythm and the balance, in particular to the timing of the finish.
- The exercises that allow for the "stop" at a precise point in the stroke cycle permit us to check that all of the rowers in a crew find the correct position at the same time.

| Exercise | Technical Benefits | Possible Problems Derived From Abuse |
|---|---|---|
| 1. Rowing with square blades | · quick extraction<br>· powerful finish<br>· prevents lowering the wrists<br>· adds balance and self-confidence | · squeeze the handles too tight during the recovery<br>· boring training |

| Exercise | Technical Benefits | Possible Problems Derived From Abuse |
|---|---|---|
| 2. Row with the seat fixed | · opening of the back and the shoulders at the entry<br>· sensitization of the release and the start of the recovery with the hands if used with the movement of the body<br>· control of the sculls with the hands and the forearms<br>· improvement in balance and increase in confidence | |
| 3. Rowing at 1/4,1/2, and 3/4 slide | · quick entry<br>· acceleration of the power applied by the legs that increase proportionally with the slide<br>· awareness of the length and the opportunity to row with strokes sufficiently long<br>· propaedeutic for learning the technique of the start | · lack of precision in the speed of the slide in the attack<br>· can accustom and enter raising the upper body |
| 4. Stop at the finish | · awareness of the position and height of the hands at the finish<br>· distance of the hands at the finish<br>· power in the finish observing the puddles or whirlpools that race away | · encourage feathering under water<br>· discourages a harmonious release |
| 5. Row with thumbs off | · relaxes the grip<br>· little tension on the forearms<br>· builds confidence<br>· lateral control | |
| 6. Single strokes | · controls the balance<br>· allows you to clearly see the course of the boat<br>· it takes time to prepare the movement of the recovery<br>· check the height of the hands<br>· balance and self-confidence | · lose the rhythm of the stroke cycle<br>· more difficult to balance |
| 7. Row at a low stroke rate (16-18 strokes per minute) for brief periods | · perception of the acceleration of the power application<br>· perception of the course of the boat in the drive and in the recovery<br>· check on the correct recovery to follow | · strokes at two times to cause a bigger resistance<br>· stiffening of the muscles |
| 8. Row with the eyes closed | · helps to perceive the exact sensation of rhythm and time<br>· helps to relax and facilitate balance<br>· the athlete can fix the imagine for developing a particular technique, for example the control of the position of the blade at the entry | |

Note: In these exercises it is useful to alternate squared blades and feathering. In all the cases, it is important to emphasize experimenting - on the part of the coach and the rower - of the concentration perceived motion for the exact execution of the exercises in function of the objective.