

# UNIT 5

## STRENGTH DEVELOPMENT



# Designing, Implementing and Coaching Strength Training Programs for Beginner and Intermediate Level Athletes – Part 1 : Designing the Program

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## Introduction

Levels of strength can discriminate between athletes of different abilities in sports such as rugby union, rugby league, American football, kayaking, volleyball and rowing. Consequently strength training is an integral part of the physical training for a number of sports. The purpose of this series of articles is outline the theory and practice of designing an appropriate strength program, implementing the strength program and the coaching of a strength program for beginner and intermediate level athletes. For the purpose of this manuscript a beginner will be defined as an athlete who has not undergone any regimented systematic strength training program. An intermediate level athlete will be defined as an athlete who has undergone at least one cycle of a beginners strength program.

## Designing the Program

## Defining the Objectives.

Strength training should be a planned, methodical and objective process. Unfortunately due to the ubiquitous influence of bodybuilding methodologies, for example the "muscle confusion principle", the strength training processes can become confusing for coaches. One of the most distinguishable attributes of competent coaches is their ability to set goals, plan strategies to attain those goals and then put into exact measures that will allow for the attainment of the defined goals. Thus strength training, as a microcosm of the entire coaching process, should reflect these processes.

Therefore the first aspect of designing the strength training program is to define the objectives of the strength training

process. These objectives may themselves need to be based upon scientific (needs analysis or game analysis) or perhaps more empirical data. Nonetheless the entire strength training process should be objective driven. In fact strength training provides an excellent opportunity for defining concrete objectives (such as weight lifted, power produced, body weight increased) and planning measures for attaining these objectives.

The difficult aspect is defining the appropriate objectives and choosing the methods to attain these objectives. For the beginner and intermediate level athlete the defining of objectives is less complicated than with advanced athletes, as almost universally at this training age (Training to train) training is concerned with increasing basic strength, increasing body mass and basic preparation for the training to follow in the years to come. Table 1 outlines some of the most common general objectives for beginner and intermediate level athletes.

**Table 1.** The common general objectives of the strength training process for beginner and intermediate level athletes.

### Beginners

1. Introduction to strength training methods.
2. Increase muscular endurance
3. Increase muscular (intr- & intra-) co ordination, leading to an increase in strength.
4. Increase torso stability
5. Increase hypertrophy and muscle balance.

### Intermediates

1. General strength
2. Hypertrophy & muscle balance
3. Introduction to power training methods

4. Increased torso stability under high loading

A certain level of strength (in kg lifted in a bench press or front squat) or an increase in body mass can provide objective data that can be deemed specific objectives. Some objectives can also seem somewhat subjective in nature or assessment. The objective of a young athlete developing good torso stability under loading is a prime example, as it often relies on the subjective decision of the strength coach / physiotherapist as to when it has been attained. However the further future integration of computer technology with the basic barbell will tend to make formerly subjective methods of assessment more objective.

For motivation, goal setting and reinforcement it is important to provide athletes with specific individualised objectives where possible (for example "X" amount of weight lifted for a 3RM in the front squat) (Wilks, 1994a).

Once the objectives have been chosen it is necessary to design the strength program. There are a number of strength training variables that must be considered. It is the acute manipulation of the training variables that allows for the attainment of the chosen objectives. **Eight variables of strength training program design**

In designing a strength training program there are at least eight variables which must be considered, if the program is to exert control over the strength training process. These variables are the exercise, the repetitions, the sets, the load upon the barbell, the order of exercises, the speed of lifting, the rest period between sets and/or exercise, and the periodisation structure.

For beginner and intermediate athletes. Whose objectives are generally an increase in general strength, an increase in body mass, improved torso stability, balanced musculoskeletal development and basic preparation for the future training years, the eight variables maybe manipulated in the following manner.

### 1. Exercise

The exercises selected in a strength training program must help to achieve the chosen objective and be appropriate to the athlete, the stage of training, the facilities available and so forth. Exercises differ from each other in the muscles used, the range of movement, the speed of movement, the biomechanics and so on. Exercises may be deemed core or assistant exercises, general, specific, single joint or multi-joint, beginner or advanced and so forth.

The vast array of definitions and classifications can also be seemingly confusing to a coach. A simplified method of classifications and choosing exercises is to use the method that has been previously outlined (Baker, 1995). Exercises are classified as either being chosen for the prime objective of developing strength or power. These two broad groups (strength exercises and power exercises) can be further divided into core and assistant power exercises. As an example of core and assistant strength and power exercises appropriate to this training age are present in the example programs. Exercises from these two broad groups may also achieve, depending upon the manipulation of other training variables, other objectives, such as developing hypertrophy or agility.

For the beginner and intermediate level athlete the core and assistant strength exercises are of the most important in achieving the objectives outlined in Table 1.

The assistant power exercises play an increasing role with increased strength development. (i.e. with intermediate level athletes) whilst the core power exercises may not be used till the second or third year of training (or third strength training cycle).

Thus the simple core strength movements of front squat, squat, bench press and chin up (lat pulldown) may constitute the bulk of the training prescription, with assistant strength exercises such as various shoulder presses, rows, curls, etc. added to aid in hypertrophy and balanced muscle development. Very basic assistant power exercises such as slow power shrugs and clean pulls can also be chosen as not only do they provide an introduction to power training concepts and methodologies, but are almost unparalleled in their ability to develop torso stability.

Consequently the basis premise for the beginner is to chose the simplest exercise that allows for the attainment of the objectives. The intermediate level athlete will be able to perform slightly more difficult exercises such as the assistant power exercises.

### 2. Repetitions

The repetitions performed is an important variable influencing both volume (the amount of work) and the intensity (the degree of difficulty of the training). As a general rule the repetitions for a beginner should be high (8-15) and moderately high for intermediate athletes (5-10 or 12). The number of repetitions are also influenced by the exercise to be performed (strength vs power, core vs assistance).

High repetitions with low to medium weights, allow for the concrete formation of the motor skill of the exercise, muscle endurance, hypertrophy and torso stability. Each repetition should be seen as a trial for motor skill development and accordingly using high

repetitions with beginners will allow for the quickest and safest development of the skill which may last for the athlete's competitive career (8-12 years). High repetitions also allow a high volume to be attained, ensuring a highly anaerobic state within the muscle tissue. This is a situation favourable to the development of both muscle endurance and hypertrophy.

More moderate repetitions will allow for the use of heavier loads, which will tend to develop strength through increased recruitment, rate coding and synchronization of motor units. The power exercises will use less repetitions than the strength exercises, so that a high speed of execution can be maintained. The fatigue associated with high repetitions will impair speed and technique in power movements, which is a highly undesirable situation. In general, the core exercises will tend to use lower repetitions than the assistance exercises in the later stages of a strength training cycle (for example, the core strength exercises are developing strength and the assistance strength exercises are developing hypertrophy.

Whilst these are general principles for selecting the repetition structure, it should be noted that the repetitions structure changes every few weeks, such that the intensity is cycled up and the volume cycled down (see table 2). The repetitions are higher at the beginning of a cycle and lower at the end of a cycle. Thus the athletes strength capabilities are "peaked" at the end of a cycle and should coincide with testing to determine if the specific objectives have been attained.

### 3. Sets

The number of sets performed influences the volume of training and the magnitude of the overload. For beginner athletes this influences skill formation (that is the skill of the strength

exercise), muscle endurance and hypertrophy. For intermediates the number of sets is more important as a method of ensuring overload.

For beginners normally two sets per exercise will suffice in the first two weeks as the repetitions will be high, and hence fatiguing. Furthermore beginners do generally not have intensive stores of ATP-PC or glycogen to allow a much higher work load than two sets per exercise. By the third week of training however the number of sets can be increased to three and can be maintained at that level till the completion of the cycle. Intermediate level athletes who have become accustomed to the strength training process (completing cycle #2 or #3) can increase the number of sets to four on the core strength and assistance power exercise during the early stages of their cycle then they are doing 8-10 repetitions (only three sets should be done if commencing the cycle with 12 repetitions). This procedure will ensure a greater overload in volume with work load and hopefully a greater hypertrophic response. The assistance strength exercises are maintained at three sets. In the later stages of the intermediate level cycle, the number of sets in the core strength and assisted power exercises are reduced to three to compensate for an increase in weight upon the bar and to reduce training volume such that a peak in strength occurs. This pronounced drop in volume and rise in intensity, outlined in Table 2, in the final two weeks of a cycle is important for peaking strength (Wilks, 1994a). It should be noted it is more pronounced for the intermediate (for example, volume of 32 repetitions dropping to 18 repetitions compared to 30 dropping to 24) than for the beginner. If a 3RM test is conducted in the last week, then there is an even more pronounced drop in volume and rise in intensity. Consequently strength levels will be highest at this point.

**4. Load upon the barbell** The load or weight upon the barbell is one of the most vital, though largely ignored, strength training variables. Whilst the number of repetitions to be performed largely dictates the load upon the barbell, there is still room for

press and power clean (and whole body assistance power exercises such as push press, clean pull, power shrugs) than in isolated assistance strength exercises (curies, leg curies etc.). Hence it appears to be related to the magnitude of the system load (body mass plus mass of barbell)

**Table 2:** The sets and repetitions for core strength training exercises over an eight week cycle for beginner and intermediate level athletes. Volume is the total number of repetitions. Strength testing takes place after the last week of training.

Beginners cycle	Weeks	1-2	3-4	5-6	7-8	
	(S x R)	2 x 15	3 x 12	3 x 10	3 x 8	
	(Volume)	30	36	30	24	
Intermediates cycle	(S x R)	3 x 12	4 x 10	4 x 8	3 x 6	
	(Volume)	36	40	32	18	
Intermediate # 2	(S x R)	4 x 10	4 x 8	4 x 6	3 x 5	
	(Volume)	40	32	24	15	
Intermediate #2	Weeks	1-2	3-5	6-8	9-10	
	(S x R)	4 x 10	4 x 8	4 x 6	3 x 5	
	(Volume)	40	32	24	15	
Intermediate #2	Weeks	1-2	3-4	5-6	7-8	9-10
	(S x R)	3 x 12	4 x 10	4 x 8	4 x 6	3 x 5
	(Volume)	36	40	32	24	15

S(S x R) + Sets x repetitions  
 (Volume) = the produce of the sets x repetitions e.g 3 x 10 = Av volume of 30 repetitions

more finite planning of the exact weight used to achieve a precisely planned overload for a training session. Though contrary to popular scientific opinion, it is not necessary or wise to use a load that signifies a RM effort for each set or workout. Practical experience has illustrated that the continual use of RM loads, even if the load is periodised from high repetitions to low repetitions, may induce neural fatigue or a form of overtraining. This results in a marked and rapid loss of strength, more pronounced in intermediates and advanced strength training athletes, than beginners.

Training to close to failure with repetitions load will also cause premature fatigue results in a marked decrease in workload for ensuring sets or exercise (Sforzo and Touey 1996). Table 3 provides an example of the decrease in workload caused by using too high a load upon the barbell and the resultant drop in workload. This occurrence appears more pronounced in whole body core exercises such as squats, front squats, bench

rather than merely relative intensity.

Consequently the load upon the barbell at the beginning of a cycle is initially low in terms of absolute weight lifted and in relative terms for whole body exercises (circa 70%-80% of the designated RM load). This light load allows the beginner and intermediate level athletes to concentrate on developing sound technique without having to worry about whether the set will be successfully completed,

Throughout the training cycle the load upon the barbell becomes closer to the RM effort for the number of repetitions to be performed. Only in the last few weeks will the weight upon the barbell be equivalent to the RM effort for the designated repetitions. Within one to two weeks of the load upon the barbell being close to or equivalent of the RM effort there will be a peak in strength, followed inevitably by a decrease in strength (irrespective of what the strength coach implements).

This peak should coincide with the strength testing.

Figure 1 provides a graphic example of this notion for an intermediate athlete who has previously performed three training cycles. In this example of an eight week training cycle, the repetitions are reduced every two weeks (from sets of ten repetitions to sets of eight, sets of six and finally sets of five). However the athlete starts squatting with 80kg for ten repetitions, even though their 10RM is 100kg. Every week the load upon the barbell is increased such that the disparity between what the athlete actually uses for a given repetition schedule and what their RM capabilities for that schedule are, become less and less. Thus in week 1 there is a 20 kg disparity between the training weight and the RM weight that could be used. In week 3 there is only a 12.5 kg disparity, which is gradually reduced to only 10kg by week 4. Consequently by week 6 the athlete is training with 125 kg for 6 repetitions, whilst the 6 RM equals 130kg. By week 8 the athlete is training with the heaviest load possible of 140kg for 5 repetitions, which is also equivalent to the 5 RM for that day. The load upon the barbell and the level of effort needed to lift that load have gradually increased across the eight weeks.

Intermediate level athletes also require the use of the "heavy-light"- system of loading on whole body exercises (Wilks, 1994a; Wilks, 1994b). Under this system if an exercise is performed twice per week, then one workout is heavier and one workout of medium intensity (minus 5-20 kg compared to the heavy day load of the week). This procedure of contrasting loads results in improved recovery from the heavy workout, increased technical mastery of the exercise, increased power output during the exercise performance and an improved super compensatory adaptation. A simple method of invoking this principle for squat training would be to use squat on the heavy leg training day and front squats on the "light" training

day. As front squats can usually only be performed with 80-88% of the load of the squat for the same number of repetitions (Hakkinen et al.,1987) this results in a reduction of loading upon the legs. The same procedure can be utilised for bench press and narrow grip bench press, clean pulls and power shrugs and so on.

Experience has also dictated that most strength training athletes tend to lift up heavy a load upon the barbell too early in their strength training cycle, which will therefore reduce the overload during the latter stages of the cycle, when the strength and power should be peaking. It is vital that the strength coach ensures tight and rigid control over what load is upon the barbell to ensure against premature peaking (followed by plateauing and then a decline) in strength.

magnitude of loads lifted in the assistant strength exercises and the fact that an increase of 2.5kg may represent a high relative % of maximum, an increase every two weeks is often more prudent for exercises from this classification. There should be greater variation in both absolute and relative loading for the whole body exercises than for isolation exercises. 5. Order of exercises  
The order of exercise performance greatly influences the physiological effects of strength training (Sforzo and Touey, 1996). The issues to be considered are the straight sets vs circuit systems of training, whole body (multi-joint) exercises vs isolated exercises, upper vs lower body exercises, strength vs power exercises, agonist/antagonist super sets and the use of contrasting loading.

**Table 3** The decrease in workload caused by selecting an inappropriately heavy load for the number of repetitions to be performed. The use of a submaximal RM load, such as training at 90% of the 12 RM rather than the full 12 RM load of 77.5 kg causes an increase in the workload by 16% (2520 vs 2170 kg) in comparison to training to failure which usually results in less repetitions to be performed in succeeding sets.

A 12 RM lifting to failure	vs	Training at 90% of the 12 RM
Set 1 = 12 x 77.5 kg = 930 kg		Set 1 = 12 x 70 kg = 840kg
Set 2 = *9 x 77.5 kg = 697.5 kg		Set 2 = 12 x 70 kg = 840kg
Set 3 = *7 x 77.5 kg = 542.5 kg		Set 3 = 12 x 70 kg = 840 kg
<hr/>		<hr/>
Total Workload = 2170 kg	vs	Total Workload = 2520 kg
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\* Training to failure on the first (or any) set generally results in less repetitions being performed in the following sets

Thus the role of the strength coach is select the exact load upon the barbell to ensure the appropriate overload for an athlete for a given stage of the training cycle. This should entail relatively lighter loads earlier in the training cycle, building to a crescendo of intensity in the latter stages of the training cycle. Ideally the load upon the barbell should increase every week for the core strength and for both the core and assistant power exercises. Due to the smaller

If strength and power are the ultimate objectives of training then the straight sets system of training, rather than the circuit system, would provide a more appropriate method. Circuit training results in reduced intensity, in terms of load upon the barbell and speed of lifting to fully develop strength or power, respectively, and consequently serve as a method of strength-endurance training. Research and experience clearly shows that whole body or multi-

joint exercises should be performed as isolated exercises using the same muscle groups, or a dramatic reduction in workload occurs (Sforzo and Touey, 1996).

The efficiency of performing lower body exercises first in a workout has not been clearly established. Generally whatever body area requires a priority in training should be trained first. A more important consideration may be whether to perform power or strength exercises first. It may remain an individual preference or a matter for successful time-equipment management (see part 2) as to whether lower body or upper body is trained first.

As a general rule it is believed power exercises should be performed first in the workout to ensure that the residual fatigue stemming from the performance of strength exercises does not reduce speed of performance and less than optimal motor unit recruitment (Zatorky, 1995). However as the training regimen of beginners should not contain any core power exercises this point is less relevant to that group. Whilst beginners may perform exercises deemed as assistance power exercises (slow clean pull to waist, slow power shrug), the slow speed of lifting that should be prescribed in these early stages to assist technical development, hypertrophy and torso stability results in these exercises not having a true power training effect<sup>1</sup>. As a result, beginners may perform the assistance power exercises after the core strength exercises.

For intermediate level athletes in their third strength training cycle, the use of contrasting exercises and loads may prove a useful power training (Bulgarian and Russian speed-strength methods) characterised by, for example, the alternating of heavy squats to stimulate strength and reduce neural inhibition and light jump squats to facilitate power production (Baker, 1994). Other examples appropriate for the intermediate level athlete may be

power shrugs verses power cleans from the hang and the bench press verses bench press throw in the smith machine.

The alternating of sets of agonist and antagonist exercises, whilst still respecting an appropriate rest interval, is also a method that warrants consideration. Essentially this cannot be done effectively for lower body exercises of the lower body use both the quadriceps (to the extend the knee) and the hamstrings (to extend the hip) within the same repetition. However alternating sets of agonist/antagonist exercises for the upper body is a useful method for developing hypertrophy, muscle balance and most importantly allowing efficient time and equipment usage (see part 2). 6. Speed of lifting

The speed of lifting is a variable that influences the strength, power or hypertrophic effects of strength training exercises. An increased time under tension/slow speed of lifting is a variable which largely influences hypertrophy, whilst an increased speed of lifting influences power, irrespective of the training age. For beginners a very slow speed of lifting ensures the successful formation of the motor skill of the strength exercises, increases the anaerobic capacities of the muscles and aids in the development of torso stability.

The speed of lifting is largely controlled by the eccentric speed of movement and to a lesser degree whether there is an isometric pause within the movement. The concentric lifting speed, apart from the initial weeks of a training cycle, should be as explosive as possible for most athletes.

On lower body multi joint exercises such as the squat, and slow power shrug a four second eccentric portion and a one second isometric pause at the bottom of the movement in the first two weeks of training may be warranted. Gradually the speed of lifting is increased (three seconds eccentric to two seconds and no isometric pause)

as the weight upon the barbell and technical control increases. For the upper body exercises such as the bench press, where there is a decreased range of movement and external stability afforded by the bench, a three second eccentric portion within 2-3 weeks.

As a general, the speed of lifting is slow at first, gradually increasing with increased technical control and heavier loads upon the barbell. This applies to the core and assistance strength exercises and the assistance power exercises. It may be unnecessary to revert to very slow training for more than 2-4 weeks each year, at the commencement of the strength training cycle or when rehabilitating injuries.

As the objective of training moves towards both developing both strength and power (intermediate cycles#2 & 3) the speed of lifting of the assistance power exercises increases markedly and the core power exercises may be introduced in the third cycle, if they are deemed necessary. Thus the speed of lifting is periodised or cycled according to the exercise being performed and the underlying objectives of the workout, week or cycle. If athletes cannot exert great control at slow speeds and with low weight, then there is little chance they could manage to perform strength or power exercises safely with high loads or fast speeds. The premise of learning to "Learn to crawl, before you walk, before you run" may be an apt analogy for the concept of exerting control of the speed of lifting variable in strength training program design.

## 7. Rest periods

The rest periods between sets or exercises influences strength, hypertrophy, power and muscular endurance through the differing effects that rest periods may exert upon energy substrate

utilisation, motor unit recruitment / patterns of firing and hormonal response. There are distinct workload and hormonal effects due to short (one to two minutes or less) or long rest (three minutes or more) periods.

For the beginner the first weeks of training are characterised by shorter rest periods (1-2 minutes) as the objectives of these early stage of training are muscle endurance / conditioning and motor skill acquisition, performed against a background of low loads. The high repetitions and short rest periods indicative of these early weeks of a training cycle also appear to favourably influence hypertrophic adaptations, possibly through an interplay of anaerobic and hormonal responses.

However as strength must also be addressed by the utilisation of heavy loads to ensure high motor unit recruitment and rate coding, then rest periods have to be lengthened towards the latter stages of the strength training cycle to allow for the lifting of heavier loads. For beginner and intermediate level athletes the rest periods between sets with heavy 5-6 repetition loads (approaching the RM capabilities) in the core strength exercises may be in order of 3-5 minutes (Zatorky, 1995). The rest period for assistance strength exercises can be maintained at two minutes or even at one minute when performing agonist / antagonist super sets. Power exercises require full rest periods for optimal speed overload. However as the time for the execution of power exercises is shorter, due to their increased speed of performance, recovery is quicker. The rest period may range from one minute for a low intensity plyometric to two minutes for jump squats to three minutes to power clean from the hang. The increasing use of computer technology to aid the measuring and training of power will enable the coach to more accurately determine the rest period for power training exercises for each individual. Any pronounced drop

in power from one set to the next will indicate that the rest period may not have been adequate.

As a general rule of strength training for beginner and intermediate level athletes, do not commence the following set until the heart rate drops below 108 bpm. Of course sometimes this procedure may be unclear as the future performance of a very intense load (close to the full 5-6RM in the latter weeks of a cycle) may cause the heart rate to stay elevated due to anxiety rather than fatigue. The subjective eye of the coach and the feeling of the athlete may prove more potent indicators of readiness to lift intense or powerful loads rather than the objective passage of time.

## 8. Periodisation structure

Periodisation refers to the division of the training year or period into smaller more manageable periods with differing objectives and content (differing manipulation of training variables). Periodisation as a concept should be viewed as broad method of effectively implementing training (Zatorky, 1995). In the strength training context it influences the length of the entire cycle (the macrocycle), the smaller sub-cycles of 2-4 weeks duration (mesocycles), the weekly cycle (microcycle), the number of days trained per week and how long the manipulation of training variables fits into the overall plan. Strict adherence to a dogmatic paradigm of periodisation, such as only using three week mesocycles for maximum strength training (Bompa, 1993), may be unwarranted.

Essentially the periodisation structure should merely be the attempt to bring together the seven other strength training variables in a methodical and coherent system of training. By observing the periodisation of the other seven variables (ie. the acute manipulation of these variables across a number of weeks), a virtual road map detailing how the training objectives will be attained,

should be developed. Tables 4 and 5 provide an example of an actual training program used by one athlete at his beginner and intermediate level stage of development. The acute manipulation of variables across the cycles is easily observed. Consequently the periodisation structure can be seen as the method by which the manipulation of training variables is structured.

By studying the program examples, it should become obvious that the athlete and coach should be in no doubt as in what to do for each and every workout. Furthermore, how the successful completion of each workout is a small step in achieving the programs goals should be apparent.

In developing the periodisation structure, it is simple to start with the small units such as how many days per week and the length of time per day. A three day per week, one hour per day system is very effective, although good results can be obtained with two days per week in beginners. Four days per week (upper body / lower body split routine) can be used for intermediate #2 athletes, if preferred. It is not necessary or prudent for beginner athletes to perform strength training for more than three days per week and intermediate level athletes four days per week. Five and six days per week of strength training is definitely ineffective and counterproductive for strength development in drug free athletes performing heavy strength training exercises. A six week macrocycle would appear the minimum length of time necessary for a beginners strength training cycle. For beginners and intermediate level #1 athletes an eight week macrocycle, preceded and followed by strength testing and exercise familiarisation, appears to be a more effective variant. This cycle would comprise of four 2 week mesocycles. Intermediate level #2 athletes may require a ten week macrocycle with variations being five 2 week mesocycles or using a 2 week

mesocycle at the beginning and at the end of the cycle with two 3 week mesocycles in between. As athletes become stronger, the length of the macrocycle necessary to produce improvements also increases (eight weeks for beginners, ten for intermediate, twelve for advanced) and the mesocycle increase in length up to 3-4 weeks, as opposed to two weeks (Wilks, 1994).

Over the long term, each macrocycle of training prepares the athlete for the next cycle of training. Thus a calendar year of strength training may be viewed as, for example, the accumulation of two back to back development macrocycles of eight weeks each (ie. a general and specific preparation macrocycle), followed by three seven week in-season maintenance macrocycles. The consequence of such training is that the strength training stimulus is presented in a wave like manner across many months (ie. higher volume and lower intensity at the beginning of each macrocycle and vica versa at the end of the cycle). Thus the cumulative effects of strength training should be taken into account as should the time needed to transform weight room improvements into sporting field improvements (process of delayed transmutation, Zatiorsky, 1995).

Whilst the above may be general rules of thumb regarding the effective planning of macro and mesocycles, the reality of planning in many Australian sports should take into consideration socio-cultural events. For example, the winter sports such as the football codes usually commence training during the first week of the football financial year (first week in November), but must cease the week before Christmas-New Year. Thus only a seven week cycle is usually possible before the cessation of training. After the New Year then only a six to eight week cycle may be possible before reverting to a maintenance cycle (Baker 1995).

Experience dictates that the length of these macrocycles and the interruption of the holiday period is less than optimal in physiological terms, but in reality an unavoidable and perhaps psychologically favourable phenomenon. Therefore training must be planned accordingly.

For beginner and #1 level intermediate athletes, the above scenario does not pose a severe problem as two full peaking cycles can be achieved within these time periods at this stage of development. For more advanced intermediates faced by the above scenario, only one true peak can be achieved at the end of the second cycle, with the first cycle serving as a "sub peak" to gauge training progress.

Consequently periodisation should be concerned less with the dogmatic adherence to periodisation theories in mind and more with the practical implementation of training.

Whilst a ten week cycle may appear the most optimal for a intermediate level athlete, a seven week cycle may have to suffice in reality due to unavoidable "breaks" in training such as holidays etc.

Thus the strength coach cannot control the socio-cultural events of a country but they can control the strength training plan to reap the most rewarding result in any given situation.

#### Conclusion

A philosophy of the theoretical and practical aspects of designing strength training programs for beginner and intermediate level athletes has been presented.

Strength training should be an objective driven process. The basis of strength training program design is the control and manipulation of the eight variables of strength training which the coach can influence. Each of these eight variables and the effect of their different manipulations upon strength is discussed. The acute manipulation of these variables occurs to achieve the changes in objectives that result from different periodisation phases or training age stages. Examples of the design of beginner and intermediate level athletes strength training programs have been presented.

**Figure 1 :** The relationship between the maximum strength capabilities for any given repetition assignment, the actual training load used for that repetition assignment and the stage of macrocycle. The Athlete uses 80 kg for 10 reps in the squat in week 1, even though at that stage his 10 RM was cica 100kg. In the last training week the load upon the barbell is 140 kg for five reps, equivalent to the 5 RM. Only in the last weeks of a macro cycle do the RM capabilities and actual training load closely equate. This process causes the peaking of strength in the following week (s) (week 9, coinciding with strength testing, see the below example).

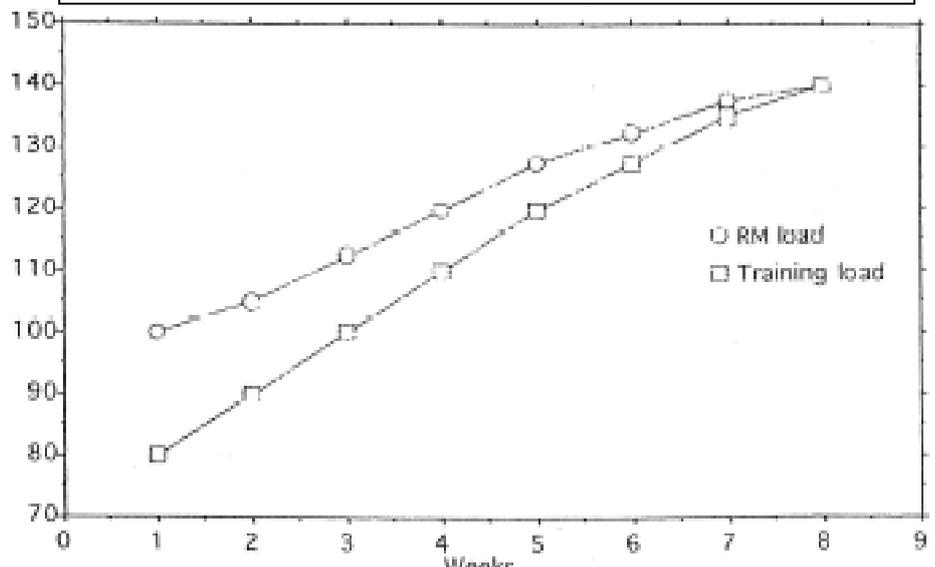


Table 3 – Part "A"										
Day 1	Beginners Basic Program Test # 1 results			Bwt = 79			Front Squat = 70		Chin = 94 (+15 kg)	
ORDER	EXERCISE	WEEK	1	2	3	4	5	6	7	8
		WEIGHT	45	50	55	60	65	70	75	80
1	Squats	SETS X REPS	2 X 15	2x15	3x12	3x12	3x10	3x10	3x8	3x8
		SPEED	411	411	31x	31x	20x	20x	20x	20x
		REST PERIOD	2	2	2	2	3	3	3	3
	Power Shrugs	WEIGHT	27.5	32.5	37.5	42.5	47.5	52.5	57.5	62.5
2	onto toes	SETS X REPS	2X10	2X10	3X8	3X8	3X6	3X6	3X5	3X5
		SPEED	512	512	41x	41x	31x	31x	21x	21x
		REST PERIOD	2	2	2	2	3	3	3	3
3	Bench Press	WEIGHT	50	52.5	55	57.5	62.5	67.5	70	72.5 Goal = 80 kg
		SETS X REPS	2x12	2x12	3x10	3x10	3x8	3x8	3X6	3 X 6 Test RM
		SPEED	311	311	21X	21X	20X	10X	10X	
		REST PERIOD	2	2	2.5	2.5	3	3	3	3
4A	Press behind	WEIGHT	22.5	22.5	25	25	27.5	30	32.5	35
	Neck (seated)	SETS X REPS	2X15	2X15	3X12	3X12	3X10	3X10	3X8	3X8
		SPEED	211	211	21X	21X	20X	20X	10X	10X
		REST PERIOD	1	1	1.5	1.5	2	2	2	2
4B	Chins (close grip) do	WEIGHT	Bwt	Bwt	+5	+5	+7.5	+10	+12.5	+15 Goal= + 22.5kg
	Pulldowns if chins	SETS X REPS	2 X 10	2X10	3X8	3X8	3X6	3X6	3X5	3 X 5 Test 3RM
	Can't be performed	SPEED	20X	20X	20X	20X	20X	20X	20X	20X
	For the # of reps	REST PERIOD	2	2	3	3	3	3	3	3
5	Curls	WEIGHT	15	15	17.5	17.5	20	20	22.5	25
		SETS X REPS	2 X 15	2X15	3X12	3X12	3X10	3X10	3X8	3X8
		SPEED	201	201	201	201	201	201	201	201
		REST PERIOD	1	1	1.5	1.5	2	2	2	2
	Abdominals		2 x 8-15							
Day 2	<b>Table 3 – Part "B"</b>									
ORDER	EXERCISE	WEEK	1	2	3	4	5	6	7	8 Goal =
1	Front Squats	WEIGHT	37.5	42.5	47.5	52.5	57.5	62.5	67.5	72.5 90kg
		SETS X REPS	2X12	2X12	3X10	3X10	3X8	3x8	3x6	3x6 Test 3 RM
		SPEED	311	311	21X	21X	20X	20X	20X	20X
		REST PERIOD	2	2	2.5	2.5	3	3	3	3
2	Clean Pull	WEIGHT	27.5	32.5	37.5	42.5	47.5	52.5	57.5	62.5
	from mid-shin,	SETS X REPS	2X10	2X10	3X8	3X8	3X6	3X6	3X5	3X5
	pause at knee	SPEED	2X	2X	2X	1X	1X	1X	1X	1x
		REST PERIOD	2	2	2	2	3	3	3	3
3	Narrow grip	WEIGHT	45	47.5	50	52.5	55	57.5	60	60
	bench press	SETS X REPS	2X12	2X12	3X10	3X10	3X8	3X8	3X6	3X6
		SPEED	311	311	21X	21X	20X	20X	10X	10X
		REST PERIOD	2	2	2.5	2.5	3	3	3	3
4a	Seated front	WEIGHT	22.5	22.5	25	27.5	30	32.5	35	37.5
	shoulder press	SETS X REPS	2X15	2X15	3X12	3X12	3X10	3X10	3X8	3X8
		SPEED	211	211	21X	21X	20X	20X	20X	20X
		REST PERIOD	1	1	1.5	1.5	2	2	2	2
4b	Wide Grip	WEIGHT	30	32.5	35	37.5	40	42.5	45	47.5
	pulldowns behind	SETS X REPS	2X15	2X15	3X12	3X12	3X10	3X10	3X8	3X8
		SPEED	311	311	21X	21X	20X	20X	20X	20x
		REST PERIOD	1	1	1.5	1.5	2	2	2	2
5a	Dips	WEIGHT	Bwt	Bwt	+5	+5	+7.5	+7.5	+10	+10
		SETS X REPS	2X15	2X15	2X12	2X12	3X10	3X10	3X8	3x8
		SPEED	211	211	21X	21X	20X	20X	10X	10x
		REST PERIOD	1	1	1	1	1	1	1	1
5b	Upright rows	WEIGHT	17.5	17.5	20	20	22.5	22.5	25	27.5
		SETS X REPS	2X15	2X15	3X12	3X12	3X10	3X10	3X8	3X8
		SPEED	211	211	21X	21X	20X	20X	10X	10X
		REST PERIOD	1	1	1.5	1.5	2	2	2	2
	Abdominals		2 x 8-15							

Table 4 – Part "A"											
Day 1	Intermediate : Program #2 Test #2			Bwt 82			Front Squat = 95		Chin = 107 (+25kg)		
ORDER	EXERCISE	WEEK	1	2	3	4	5	6	7	8	
		WEIGHT	65	70	75	80	85	90	95	100	
1	Squats	SETS X REPS	3x12	3x12	3x10	3x10	3x8	3x8	3x6	3x6	
		SPEED	211	211	20x	20x	20x	20x	20x	20x	
		REST PERIOD	3	3	3	3	3	3	3	3	
	Power Shrugs	WEIGHT	52.5	57.5	62.5	67.5	72.5	77.5	82.5	85	
2	onto toes	SETS X REPS	3x8	3x8	3x6	3x6	3x5	3x5	3x4	3x4	
		SPEED	31x	31x	31x	31x	21x	21x	21x	21x	
		REST PERIOD	2	2	2	2	2	2	2	2	
3	Narrow Grip	WEIGHT	52.5	55	57.5	60	62.5	65	67.5	70	
	Bench Press	SETS X REPS	3x10	3x10	3x8	3x8	3x6	3x6	3x5	3x5	
		SPEED	20x	20x	20x	20x	20x	20x	10x		
		REST PERIOD	3	3	3	3	3	3	3	3	
4A	Press b back	WEIGHT	32.5	32.5	35	35	37.5	37.5	40	42.5	
		SETS X REPS	3x12	3x12	3x10	3x10	3x8	3x8	3x6	3x6	
		SPEED	211	211	20x	20x	20x	20x	20x	20x	
		REST PERIOD	2	2	2	2	2	2	2	2	
4B	Wide grip pull downs	WEIGHT	37.5	40	42.5	45	47.5	50	52.5	55	
	Behind neck	SETS X REPS	3x12	3x12	3x10	3x10	3x8	3x8	3x6	3x6	
		SPEED	211	211	20x	20x	20x	20x	20x	20x	
		REST PERIOD	2	2	2	2	2	2	2	2	
5	Curls	WEIGHT	20	20	22.5	22.5	25	25	27.5	27.5	
		SETS X REPS	3x12	3x12	3x10	3x10	3x8	3x8	3x6	3x6	
		SPEED	211	211	20x	20x	20x	20x	20x	20x	
		REST PERIOD	2	2	2	2	2	2	2	2	
	Abdominals	2 x 8-15									
Day 2	<b>Table 4 – Part "B"</b>										
ORDER	EXERCISE	WEEK	1	2	3	4	5	6	7	8	Goal =
1	Bench Press	WEIGHT	60	62.5	67.5	70	75	77.5	80	82.5	90kg
		SETS X REPS	3x10	3x10	3x8	3x8	3x6	3x6	3x5	3x5	Test 3RM
		SPEED	20x	20x	20x	20x	20x	20x	20x	20x	
		REST PERIOD	3	3	3	3	3	3	3	3	
2a	Very close grip	WEIGHT	40	42.5	45	47.5	50	52.5	55	57.5	
	Bench press	SETS X REPS	3x12	3x12	3x10	3x10	3x8	3x8	3x6	3x6	
		SPEED	211	211	20x	20x	20x	20x	20x	20x	
		REST PERIOD	2	2	2	2	2	2	3	3	
2b	Chins (close grip)	WEIGHT	BWt	BWt	+5	+10	+15	+17.5	+20	+22.5	Goal =
		SETS X REPS	3x8	3x8	3x6	3x6	3x5	3x5	3x4	3x4	+30 kg
		SPEED	20x	20x	20x	20x	20x	20x	20x	20x	Test 3 RM
		REST PERIOD	2	2	2	2	2	2	2	2	
3	Front Squats	WEIGHT	60	65	70	75	80	85	90	95	Goal =
		SETS X REPS	3x8	3x8	3x6	3x6	3x5	3x5	3x4	3x4	105 kg
		SPEED	20x	20x	20x	20x	20x	20x	20x	20x	Test 3 RM
		REST PERIOD	3	3	3	3	3	3	3	3	
4	Clean pulls	WEIGHT	52.5	57.5	62.5	67.5	72.5	77.5	82.5	85	
	To waist	SETS X REPS	3x8	3x8	3x6	3x6	3x5	3x4	3x4	3x5	
	No pauses	SPEED	X	X	X	X	X	X	X	X	
		REST PERIOD	2	2	2	2	2	2	2	2	
5	Front shoulder	WEIGHT	35	35	37.5	37.5	40	40	42.5	42.5	
	Press	SETS X REPS	3x12	3x12	3x10	3x10	3x8	3x8	3x6	3x6	
		SPEED	211	211	20x	20x	20x	20x	20x	20x	
		2	2	2	2	2	2	2	2	2	
	Abdominals	2 x 8-15									

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# Designing, Implementing and Coaching Strength Training Programs for Beginner and Intermediate Level Athletes – Part 2 :

## Implementing the Program

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### INTRODUCTION

A paucity of information exists concerning on how actually to implement a strength training program. This may be partially ascribed to unique difficulties that may not apply across situations, rendering a cross-over of data less applicable. However the author's experience in the Australian sporting environment has indicated that there are often problems encountered by strength coaches when attempting to implement a program.

Specifically these problems are what tests to implement, how to implement testing for large groups of beginner/intermediates, how to efficiently utilize equipment, time and personnel, how to individualise weight selection for different exercises and what degree of progress to expect at different training ages and stages. This paper will attempt to address these common problems associated with implementing a strength training program with practical solutions that have been used by the author.

### CHOICE OF TESTS

Testing of strength is necessary to measure

specific objectives of training and the progress to those goals, as well as allowing the strength coach to individually select the weight upon the bar for each exercise for each training session. However it is not necessary to implement a holistic battery of strength tests as a few simple tests should suffice with beginner and intermediate level athletes.

Whilst the nature of the sport often dictates which tests are most appropriate, for most field sports (football codes, hockey etc) the following tests have proven very useful for testing general strength capabilities. For upper body pushing and pulling strength, the bench press and chin up (reverse grip for beginners and female athletes) respectively have been proven easy to implement and perform by low level subjects. These strength tests have provided data which indicates that performance on these simple tests can discriminate between different level athletes, even at the earliest stages of training (Baker, 1996; Malone, 1996).

For the lower body measurement of strength the front squat is the easiest exercise to impellent for beginner and low intermediate level subjects. The front squat, from the

authors experience with hundreds of beginners and intermediate level subjects, is easier to perform and learn compared to the back squat. Furthermore there appears to be less psychological inhibitions amongst beginners to holding a bar on the front of the shoulders as compared to the back of the shoulders. This may also be due to beginners generally being able to bench press more than they can front squat, thus providing confidence about being able to handle the weight. This would not occur with the back squat, which is more difficult to master and would use a larger load than the bench press. The simple vertical jump and reach test may be implemented if the coach desires a basic leg power test.

The use of the back squat, as a test of strength, and the power clean as a test of lower body explosiveness, are best left to the later intermediate level stage, although it is not necessary to change to these tests if experience had dictated that the front squat and vertical jump have been adequate. For example, extremely tall athletes find the front square more comfortable to perform due to less forward lean. However experience had dictated that the back squat is more suitable at all

raining ages/stages for female athletes, who find it uncomfortable to perform the front squat due to the difficulty of maintaining the barbell upon the clavicles.

The use of 3RM test is recommended for beginner and intermediate level athletes as they do not often possess the neural control to safely make the quantum leap from 3 RM to 1 RM loads. If desired a 1RM can be extrapolated from a 3RM by multiplying the load by a factor of 1.08 (Baker, 1995a).

The use of a total strength score (eg. Total strength = 3RM bench press, chin up and front squat) has proven the most successful single strength measure of discriminating athletic ability, even up to the elite level (Baker, 1996, Malone, 1996).

Comparisons based on solely strength per kg greatly favour lighter athletes and are accordingly less useful for accurate analysis.

### **IMPLEMENTING THE TESTS.**

When testing larger groups of beginners and intermediates it is necessary to have a number of testers available to insure safety and efficiency. A ratio of one tester per ten athletes is recommended. Testing of large groups can be divided into two groups, with one starting with the bench press and the other, the vertical jump. Following the bench press, this group will rotate to the chin-up test and then to the vertical jump, whilst the vertical jump group will proceed to

the bench press and then the chin-up. The front squat is tested last to ensure that the athletes are fully warmed up and to utilise the larger numbers of athletes as spotters. Utilising this strength coaches, tested over 30 athletes in one hour.

Testing of strength with beginner athletes is based upon the trial and error method. With beginners start lifting with an empty barbell (six to ten repetitions) to ensure that technique is adequate. Increase the load to a load that you presume may be about 50% of the 3RM to gauge the difficulty of this load. Then increase the weight by 5 to 10 kg an attempt till the maximum is achieved. When determining a "maximum" if athletes fail to lift the third repetition in an attempt on the bench press, but manage to get the barbell halfway up or further, than subtract 2.5kg from that attempt to ascertain the 3RM (ie. two and a half repetitions with 7.5kg = a 3rm of 72.5kg). The same procedure with the front squat is also used but 5kg is reduced from failed attempts to determine the 3RM. However if athletes can only perform two repetitions, then the last successfully completed load is used as the 3RM or 5kg is subtracted from the attempted goal. The chin-up test score equals the body mass plus additional weights that were attached to the body to derive the 3RM (eg. 74kg + 7.5kg = 3RM of 81.5kg). If an athlete performs only one or two repetitions with their body weight, then subtract 5kg each rep less than 3reps to derive the chin

score. If no repetitions can be performed at all, then substitute a lat pulldown to below the chin to derive a 3RM.

With intermediate level subjects who have previously completed a test, a more precise use of loads to ascertain the 3RM can be utilised. This method is the pinpoint or goal method, whereby a certain goal weight is predetermined, based on previous test results and recent training efforts. As a general rule, athletes who perform a 3RM with 50-75kg, usually test a 5 kg more than the weight used in the last workout of 3 x 5. Athletes who lift a 3RM of 75-100kg usually test at 7.5kg more than the weight they used in their last 3 x 5 workout. Athletes who lift 100-125kg usually test at 10kg more than the weight used in their last 3x5 workout. Thus by knowing this the testing procedure can be extremely pinpointed (see table 1).

### **EFFICIENT TIME, EQUIPMENT AND PERSONNEL USAGE.**

One of the major problems faced by coaches working with amateur or low level teams is efficient usage of time, equipment and personnel. A situation where the number of athletes is much higher than the equipment available is a common problem in the Australian sporting environment. Crowded or disorganised training leads to unproductive or dangerous training as well as alienating most of the beginners from the strength training experience. From the authors experience the following procedures and methods can be useful in

ensuring a productive training environment.

The four best methods for coaching large groups of low level athletes is to 1).ensure a ratio 3:1 athletes to major exercise situations 2) stagger the starting exercise and ensuring order of exercise performance 3) stagger the starting time of the workout for different groups and 4) variation in programming (more so for intermediate level athletes).

If timetables dictate that all the athletes must start training at the same time, then a staggered starting exercise and adequate equipment are required. Attempt to have one major training station per three athletes. A major training station is defined as for core strength or assistant power exercises. A bench press, squat / power rack and platform area (plywood sheet) defines a station. Thus if 18 athletes are to train at the same time, two bench presses, two squat racks and two platform areas (and six barbells) ensure an adequate training facility by relegating the numbers of athletes to major equipment stations as 3:1. Under this procedure all 18 athletes can start training at the same time, in groups of three, starting at either bench press type exercise, a squat exercise or a assistant power exercise upon the platform. Table 2 outlines **the** specific order that can be followed for two different types of program to efficiently use time, space and personnel, whilst not corrupting training by having to perform isolation exercises before core or multi- joint exercises.

The other solution is to have staggered starting times, whereby groups start training at different 15 minute intervals. This especially suit situations where their is limited equipment. Other coaches have also used staggered training days (group "A" does lower body whilst group "B" does upper body exercises), but this is more of a method for intermediate level athletes who may be performing four days per week.

Intermediate level athletes programs become more individualised or positional specific, as compared to the general program of the beginner, resulting in less congestion in the weight room at any given point. Some coaches of intermediates also use a method whereby a body part is prescribed to be trained and the athlete chooses the exercise of their choice to perform for the prescribed number of sets and repetitions (eg Back: choose any chin, pulldown or rowing exercise). The author does not personally choose this method as it reduced the control of the coach over the training process.

For the coach to be efficient in spreading their time amongst a number of athletes, the author recommends that the coach plan the training and clearly define upon the program exactly what must be done in the workout (all eight variables are accounted for).

The goal should be to make the program "idiot proof". This will reduce the number, but never eliminate, the

frivolous questions that reduce the spread of the coaches "eye".

As a goal I recommend that the coach attempts to view at least one of each athlete performing the core or assistant power exercises during each workout. This will allow the coach to gauge the progress of every athlete they train. Make a mental note or written note (after the session) of their progress in technique development.

Efficient personnel usage can also be managed by educating the athletes to the coaching process and by making them spotters and loaders for their partners. Educating to the strength coaching process means writing or describing the key coaching cues for each exercise. Thus the training partner provides feedback concerning performance to their partner and uses a cue to reinforce aspects of performance. This concept is explained in more detail in Part 3 of the series.

#### INDIVIDULISING WEIGHT SELECTION.

The appropriate load upon the barbell is an important variable for ensuring th most appropriate overload of athletes at any given stage of training. Selecting the most appropriate load for any exercise for an individual is a difficult process until more training and testing information has been gathered. From experience, when confronted by a large number of athletes who have little or no strength training experience, the

starting weights for the most common exercises can be selected by using the percentage listed in Table 3. Consequently a starting weight for every exercise can be selected for any individual who tests. These starting weight are then increased by 5kg per week for the multi-joint low body exercises and 2.5kg for most of the upper body exercises. For upper body exercises which utilize smaller loads (e.g. Curls), then the weight may be increased only every two weeks. Female athletes may experience smaller increases of the order of 2.5kg per week for lower body exercises and 2.5kg every two weeks on the bench press.

For example, if a beginner athlete had a bench press 3RM of 60kg and is programmed to perform 2x15 in the first workout, then the starting weight would be 40kg ( $60\text{kg} \times 66\% = 40\text{kg}$ ). An intermediate who bench pressed 92.5kg for a 3RM would be using 70kg for the first workout if performing sets of ten reps ( $92.5\text{kg} \times 75\% = 70\text{kg}$ ).

It is essential that the coach ensure that these loads are manageable for the athlete so that the athlete does not train to failure, especially in the first half of a training cycle. If the loads become too easy then it is far wiser to increase them more towards the end of a cycle rather than at the beginning. This will ensure that there is a sharp rise in intensity near the end of a cycle (a peaking of strength), as is discussed in Part 1. Thus during the last week of the training cycle the athlete should be using loads that are virtually RM, so that

their strength will peak in the following week. For beginners and intermediates these loads are usually what the previous 3RM was. For example, a beginner may perform 3 x 6 at 65kg during week 8, with 65kg being the 3RM of the test performed eight weeks earlier.

Thus an effective method of selecting the load upon the barbell for the front squat, bench press and chin-up is to ascertain the starting load, based upon the load to the finishing load (eg. 3 x 5), which should be the previous test maximum. The loads for other exercises are proportionally increased.

#### STRENGTH LEVELS OF BEGINNER AND INTERMEDIATE ATHLETES.

The strength levels of male and female beginner and intermediate level athletes are outlined in Table 4. Clearly strength increases with chronological and training age.

By reviewing the normative data for different ages and training stages, a generalized picture of the strength improvements can be gained. From experience beginners make between a 1.5-2% increase per week in upper body strength for 6-12 weeks. Intermediates increase by about 1% per week for 8-12 weeks, a finding which is also reported in numerous studies (Berger, 1962; Hakkinen and Komi, 1981; Stowers et al, 1983; Hakkinen, 1985; Gater et al, 1992; Willoughby, 1993;

Baker et al, 1994; Baker 1995b).

The lower body strength changes are much larger, circa 4% per week for beginners and about 1.5-2% per week for intermediates over 6-10 weeks (see also the references listed above).

Outlined in Table 5 is an example of the progress of a group of athletes across two training cycles from beginner to intermediate level. In the first eight weeks of training the increase of bench press strength is higher (14%), as must be expected, then the following eight weeks (9%). The change in lower body strength is much higher, as compared to upper body strength, in the initial cycle is associated with a more modest increase in lower body strength, similar to that of the bench press. Thus across 16 weeks (two by 8 week training cycles) beginners can expect to improve bench press strength by about 25% and front squat strength by about 45%. The rate of improvement diminishes with increased training experience.

The data for the female athletes listed illustrates similar rates of progress of 19% in upper body strength and 43.9% in lower body strength following two 8 week strength training cycles. One reason why upper body strength increases seem to slowdown in for female athletes, may be that the smallest standard weight increment is 2.5 kg, a relative increase of 5% for the average female athlete bench press. This amount may be relatively to great for weekly or even fortnightly load increments.

It may be prudent to attempt to attain smaller weight plates (.25kg and .5kg) with female athletes so that weekly increases in upper body training weights may be implemented. Very small weight increases are physiologically and psychologically better than no increase at all.

By knowing the average rate of improvement gives the strength coach an advantage in planning what weights should be upon the bar for an individual. Knowledge of these results can also stop "poundage phobia" that young athletes often experience, whereby they believe they must be lifting huge poundages from the beginning of training.

#### CONCLUSION

The main problems facing Australian strength coaches when attempting to implement a strength training program appear to be concerned with time, equipment and personnel usage. Other problems appear to be with knowledge of testing procedures and the realistic levels of strength of beginner and intermediate level athletes. This paper has put forward methods for efficiently testing and training large groups of low level athletes. The level of strength at different ages and stages of training has also been presented

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<b>Table 1. Procedure for testing strength in beginner and intermediate level athletes.</b>													
Beginner and intermediate level test battery -	3 RM bench press + 3 RM chin-up + <u>3 RM front squat</u> = Total strength (kg)												
Female athlete test battery	3 RM bench press + 3 RM close grip pulldown /chin + 3 RM back squat = Total strength (kg)												
Intermediate Level 3 and advanced test battery -	1 RM bench press + 1 RM power clean + 1 RM back squat = Total strength (kb)												
A) Beginner's testing procedure for the first test (the trial & error approach)													
	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"><u>20KG</u></td> <td style="text-align: center;"><u>40</u></td> <td style="text-align: center;"><u>50</u></td> <td style="text-align: center;"><u>60</u></td> <td style="text-align: center;"><u>65</u></td> <td style="text-align: center;"><u>67.5</u></td> </tr> <tr> <td style="text-align: center;">6 reps</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;"><u>3</u></td> </tr> </table>	<u>20KG</u>	<u>40</u>	<u>50</u>	<u>60</u>	<u>65</u>	<u>67.5</u>	6 reps	3	3	3	3	<u>3</u>
<u>20KG</u>	<u>40</u>	<u>50</u>	<u>60</u>	<u>65</u>	<u>67.5</u>								
6 reps	3	3	3	3	<u>3</u>								
Successful 3 RM = 67.5 kg													
B) Intermediate's testing procedure (pinpoint or goal weight approach)													
(Previous 3 RM of 92.5 kg & finished the current training cycle with 3 x 5 @ 92.5 kb. Therefore 3 RM goal for this test = 100 kg)													
	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"><u>40KG</u></td> <td style="text-align: center;"><u>60</u></td> <td style="text-align: center;"><u>80</u></td> <td style="text-align: center;"><u>90</u></td> <td style="text-align: center;"><u>100</u></td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> <td style="text-align: center;"><u>1</u></td> <td style="text-align: center;">3</td> </tr> </table>	<u>40KG</u>	<u>60</u>	<u>80</u>	<u>90</u>	<u>100</u>	5	3	2	<u>1</u>	3		
<u>40KG</u>	<u>60</u>	<u>80</u>	<u>90</u>	<u>100</u>									
5	3	2	<u>1</u>	3									
Successful 3 RM = 100KG. If only 2.5 reps are performed with 1200 kg, then the 3 RM = 97.5. If only 2 reps are performed with 100KG then 3 RM = 95 KG													
<b>Table 2. A method for ensuring efficient, time equipment &amp; personnel usage by staggering the starting exercise and the subsequent order of performance of exercise by different positional sub-groups in a junior rugby union team</b>													
Exercise order by playing group													
Day "A"													
Order	Tight Five	Back row ½'s	Outside Backs										
Exercise #	1	2	3										
	2	3	1										
	3	1	2										
	4	5	7										
	5	7	4										
	6	4	5										
	7	6	6										
Exercises are ordered in the program 1) Squat 2) Power shrug 3) Bench press 4) Military press 5) Chin/pull downs 6) curl 7) abdominals.													
The athletes perform the order of exercises as described for their positional grouping. The isolation exercises of either curl or abdominals are performed last. The sets, reps, lifting speed, load on the barbell and rest period are prescribed on their individual programs.													

**Table 3.** Selecting starting loads for individual athletes for different repetitions based upon percentages of the 3 RM test loads.

<b>Exercise</b>	<b>15 reps</b>	<b>12 reps</b>	<b>10 reps</b>	<b>8 reps</b>
	(% of 3 RM bench press test)			
Bench Press	66%	70%	75%	80%
Narrow grip bench press	60%	66%	70%	75%
DB bench press	33% of the bench press starting weight			
Close grip front pulldown	60%	66%	70%	75%
Wide grip pulldown behind	40%	45%	50%	55%
DB rows (1 arm)	Same as DB bench press			
Press behind neck	33%	40%	45%	50%
Military press in front	33%	40%	45%	50%
Upright rows	25%	30%	35%	40%
Curls	20%	22.5%	25%	27.5%
DB curls	50% of the weights used for barbell curls			
Lying tricep ext.	20%	22.5%	25%	27.5%
	(% of 3 RM front squat test)			
Front squat	55%	60%	65%	70%
Squat	66%	70%	75%	80%
Power shrugs	40%	45%	50%	55%
Clean pull to waist	40%	45%	50%	55%
Step ups	25%	27.5%	30%	32.5%

**Table 4.** Comparison of strength levels of beginner and intermediate level athletes\* of different ages

	<b>3 RM Bench Press</b>	<b>3 RM Front Squat</b>
Beginner Under 17 yrs (n=88)	73.1	68.5
Intermediate Under 18 yrs (n=31)	88.1	96.6
Intermediate Under 19 yrs (n=53)	91.2	102.9
Intermediate Under 21 yrs	104.9	111.9
	<b>3 RM Bench Press</b>	<b>3 RM Full Back Squat</b>
Female Rugby Union (Beginner strength trainers) (n=21)	42.9	57.2
Female Rugby Union (Intermediate strength trainers) (n=17)	50.3	83.1

**Table 5.** Progression in strength levels for beginner to intermediate level athletes training 3 days per week

School boy 1 ST XV Rugby Union Players (n=15)	
Beginner training cycle (8 weeks)	Intermediate training cycle (8 weeks)
Bench Press 3 RM 72.6	82.8 → 90.5
	→ 14.0% → 9.3%
	→ 24.7%
Front squat 3 RM 68.3	88.9 → 98.6
	→ 30.2% → 11.0%
	→ 44.4%

# Designing, Implementing and Coaching Strength Training Programs for Beginner and Intermediate Level Athletes – Part 3 : Coaching the Program

By Daniel Baker, MHS (Sports Science), Head Strength Coach, Brisbane Broncos Rugby League, Australian U/23 Powerlifting Team

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## Introduction

The first two sections of this paper have addressed designing and implementing strength training programs. However, what constitutes the vast majority of a strength coaches time is the ongoing coaching process. This paper will address aspects of the coaching process, including motivation, goal setting, reinforcement, technical analysis and the interaction between these concepts.

## Coaching

Coaching in strength training is concerned with the methods employed by the coach to ensure that certain behaviours are persistently and consistently exhibited. These certain behaviours can be defined as exhibiting "good" technique, based upon the appropriate biomechanics for an athlete and lifting with strength and/or power. Aside from

designing the appropriate program, the coach must teach and then reinforce good technique in every repetition of every exercise which is impossible but it should be the goal of the strength coach to aspire to develop this behaviour. Consequently the strength coach of beginner and intermediate level athletes must be concerned with motivation, goal setting, reinforcement, technique teaching and modification in an effort to ensure perfect technique and strong lifting are behaviours which are consistently exhibited by the athlete.

## Motivation and Goal Setting

Motivation depends heavily upon goal setting and goal attainment (Wilks, 1994). Goals may be defined as short, medium and long term. Goals may also be defined as specific (eg. a 3RM of 100kg) and more subjective ("good technique" in the squat). A strength coach must address both forms of goal setting as developing higher levels of strength and power and developing "good" technique are inextricably woven. The first step in developing motivation and the concept of goal setting in the athlete is the provision of a written program by the coach. A program, with all eight variables of strength training accounted for, documents and codifies the athletes training goals for

the next cycle (e.g. eight weeks). Thus there are workout, weekly, mesocycle and macro-cycle goals prescribed, principally in the form of the weight to be lifted for a designated amount of repetitions.

Wilks (1994) has identified a number of features of goal setting, specific to the strength coaching process. Goals should be realistic, specific and publicly affirmed. Furthermore there should be multiple goals, which need to be reevaluated and modified so they remain realistic. Consequently the practice of testing for a 3RM in the front squat, chin-up and bench press and then prescribing retest goals is a sound method for developing motivation. The practice of prescribing the weight for every set of every exercise for every workout also aids motivation as it ensures a goal setting / attainment ethos. If these training loads that are prescribed become too difficult or easy (reevaluated), then they are modified to ensure the goals remain realistic

## Reinforcement

A reinforcer is "any event that increases the rate of occurrence of a particular behaviour." (Wilks, 1994). Positive reinforcers are the most effective methods of reinforcing behaviours and may be classified as achievement, verbal and sensation reinforcers (Wilks, 1994).

Grading of strength performances with a body weight normalising equation (eg. the Wilks or Classical formulas) can help to reinforce goal setting / attainment and therefore the whole coaching process, through instilling a sense of achievement. With four different strength measures (bench press, chin-up, front squat, and the total make the top half in one measure, when strength is normalised according to body weight Grading can also be done against the norms of the top athletes in a sport. Thus achievement reinforcers help cultivate motivation as athletes strive to achieve goals that have been set for them.

The quest for perfect technique with heavy loads should be of paramount importance. The coach and athlete should strive to achieve perfect technique and constantly reinforce this behaviour to the neuromuscular system as the appropriate behaviour. Perhaps the single most important method for reinforcing good technique in strength training is the use of the verbal reinforcement during or immediately after the completion of a set. This verbal reinforcer should contain, in order, 1) simple positive praise, 2) specific positive information concerning performance (technique) and 3) corrective information if warranted (Wiiks, 1994). Thus an example that may be used coaching the squat could be:

"Good. Your back is nice and flat Just drive the hips through more on the next rep."

After the completion of the entire set, a more detailed analysis can be given to the athlete, whilst the sensation of the lift is still clear in the athletes mind. The sensation of lifting is important for learning with low level athletes.

>The above example of verbal reinforcers is most appropriate to a lower level athlete or when intermediates are lifting only medium heavy weights as it contains many bits of information. Many bits of information cannot be effectively processed when the higher cortical centres are in high state of arousal to lift very heavy weights (when the athlete is "psyched up" to lift heavy). Therefore the verbal reinforcers for intermediates, or when lifting heavy weights that require high levels of arousal, must be concise (less bits of information). The coach uses cues or key words that equate to certain behaviours. That is, one key word means the athlete should invoke a certain behavior or technical reinforcement during lifting.

For example, coaching the squat with an intermediate who has " a habit a letting the chest drop, which will also result in hips not being pushed through during the concentric portion of the lift, could be. "Good Chest Up, Hips through" or even "Good. Chest, Hips" . A certain understanding between the athlete and the coach must exist which underlies the success of the use of cues or key words. The coach must explain that if the word, for example, "Chest" is said, it means that the athlete has made a slight mistake in technique which will be corrected by

the focus upon the corrective behaviours invoked by focusing upon "Chest".

The corrective behaviour exhibited by the athlete in response to this cue will be to automatically lift the chest higher and take a deeper breath before commencing the ensuing repetition. Consequently the incorrect behaviour (technical flaw) will be corrected by invoking this response.

Table 1 contains a number of key words and technique cues that are useful for coaching in the early to low intermediate stages of technical development. These cues have been developed based upon the authors experience that they relate to the common technique problems encountered by beginner and intermediate level, athletes. Some cues are most appropriate during the set up phase of a repetition, some during the eccentric phase and some during the concentric phase. Thus between and during every stage of a repetition the coach can provide a verbal reinforcer of what the athlete is to do regarding technique.

Tables 2 and 3 contain examples of the verbal reinforcers that can be used for an entire set of squats for respectively, a beginner and an intermediate level athlete who is high state of arousal (lifting a very heavy weight). Note that the coach provides less bits of information both during the set and after the set for the intermediate athlete to process. This is because the intermediate is better able to modify the

behaviour of the rep with just one or two key words or cues (modifying the motor schema). Because of the greater control of the intermediate over the motor skill, these technical changes occur at low level controller (spinal cord) of the neural system leaving the higher cortical level merely to think of invoking them (changes become reflexive). The cognitive centres of the higher centre are reserved for generating the high levels of arousal necessary to lift heavy loads.

#### Coaching the Skills of Strength Training Exercises

Beginner athletes should perform very basic exercises that are easy to learn and easy to coach. The basic exercises are the most appropriate for developing strength, hypertrophy and neural control in beginners. Complex skill exercises are unwarranted for beginners. Thus there is no need, for example, for an athlete to perform the power clean from the hang until they have completed at least one (preferably two) cycles of strength training (eg. 2 x 6-8 week cycles). Thus the complex skills are reserved until a future point when the athlete will already have related motor skills ingrained into the neural system (eg. power shrug, upright rows, front squats have motor skills related to and adaptable to that of the power clean from the hang). The power clean from the hang is far easier to teach if *a number of training cycles containing upright rows, power shrugs and front squats have already been completed.*

Therefore the transition from the basic skills to the complex skills need not be

that difficult if the basic tenements of skill acquisition are followed (eg. building upon the basic skills and shaping and chaining aspects of a complex exercise).

#### Beginning Stage of Learning

The coaching of most sport skills is similar. For teaching a new exercise there should be five distinct parts to coaching the process (ACC, 1990). First name the exercise and secondly demonstrate it two or three times. Third, identify two or three key aspects of performance for the athlete to focus on. Follow this by demonstrating the exercise again, illustrate the key points that were previously mentioned. The athlete will be attempting to imprint the coaches performance of these key points to their own neural network. Finally allow the athlete to practice the skill by performing a set at a very slow speed with either no weight, an empty barbell or a dowel rod. Gradually increase the speed of the performance to that which you feel is appropriate (still slow for beginners). At this stage the athlete merely needs to know if they are actually completing the exercise anywhere near to acceptable in terms of technique (ie. coach says \*Yes that is right. Nice squat, Slow and controlled. Good<sup>1)</sup>). Not too much information is provided so as not to overload the athlete. The similar aspects of technique are of little concern at this stage as the coach focuses upon the big picture. After he set, feedback concerning the outcome, which is of more importance than the performance to athletes at this low level, is provided

KR.KP:knowledge of results is more important than knowledge of performance.

#### Intermediate Stage of Learning

As the athlete practices the exercise over a number of sessions or weeks the key words or cues concerning technical performance are used for verbal reinforcement or corrective reinforcement. The coach can start to provide feedback after a repetition, as the athlete will not be so overloaded with new verbal and kinaesthetic information, as compared to the early stages of learning. Gradually more information is provided as to the reason why flaws in technique occur and what is the consequence of these flaws. The athlete does not need to concentrate so much upon outcome, but more on the aspects of technique that impact upon the outcome (ie. the key aspects or cues). Over the duration of a training cycle the cues become more concise, as described above.

In the final refinement stage of the intermediate level athlete, the athlete should be able to process the cues whilst performing the skill. The lifting speed is also much faster, allowing less time for corrective refinements during a repetition unless they have become reflexive based refinements. Feedback is based upon knowledge of performance.

Consequently the provision of cues is related to the stages of skill acquisition. Very little work is done with coaching cues when coaching a strength exercise to a beginner in

the first stage of learning as practising the basic outcome is more important. The information about technique is mainly provided after the set. For intermediates in stage two of learning, coaching cues can be provided after the repetition so that the corrective behaviour can be quickly thought about and then invoked for the following repetition. Intermediates in the third stage of skill learning can be provided with cues during a repetition as they have developed the motor schema to invoke changes in technique in a reflex based manner.

### **Analysing and Modifying Technical Behaviour Past the Beginner Stages**

In the quest to ensure athletes become strong (and/or powerful) and lift with perfect technique, the strength coach is always analysing, reinforcing or modifying technique. Perfect technique can be defined as the technique most suitable to an athlete in which they can lift the heaviest or most powerful loads in the most biomechanically sound positions. An athlete cannot attain their strength or power potential without good technique.

The coach should have a sound knowledge of the biomechanics of the exercises they coach. This will include how the worlds best perform the exercise, how the beginners perform the exercise and the multiple variations in between. They may also need to know some basic premises which influences decisions on how to perform strength training exercises.

Once these basic premises are known for a number of exercises, the coach can attempt to modify the technical behaviour of the athlete to develop the most biomechanically sound lifting behaviour.

For example, experience dictates that novices and especially females take a narrower than perpendicular grip when learning the bench press -as generally their shoulders perform less work than their arms at this stage. With increased training experience a perpendicular grip becomes most suitable as it ensures the most equitable muscle involvement and best develops strength across a number of grip variations. After this time, individuals can work to their strengths and work upon their weaknesses. For example, those with long arms and strong chests tend to take a wider grip to lift the heaviest weights and those with shorter arms take a narrower grip to lift the heaviest weights. However, neither grip should be used exclusively (eg. Train one day with a wide grip, one day with a medium grip).

From a practical coaching viewpoint the coach should attempt to position themselves in a point which allows for the best analysis of technique while the athlete performs the set. If possible they should not "spot" the lift, leaving this task to another competent athlete(s), so that the coach's entire focus can be upon technique analysis. For analysing most multi joint exercises, the coach should position themselves side on to the lift. This allows the coach to recognise when the joint alignments become less efficient during

a lift. Recognising the correct alignment of various joints during the various stages of the lift is one of the most important skills of a strength coach. The correct alignments are positively reinforced, as described above. Once an incorrect alignment is recognised (an error in technical behaviour), the coach must put into practice the corrective procedures. This may be the use of a corrective cue(s).

Thus the ongoing coaching process is inextricably linked to technical analysis and modification. Technical analysis is based upon a sound knowledge of lifting biomechanics. Modification of technical behaviour is based upon the positive reinforcement of the correct aspects of technical behaviour and the use of coaching cues to modify the motor schema in situations where incorrect joint alignments have been detected.

### **Conclusion**

The strength coaches role is to achieve persistence by the use of aspect of strength coaching as they

to ensure that athletes consistently and persistently display the behavior of lifting with good technique. They also need to ensure the behavior of being strong and powerful. The strength coach attempts to achieve persistence by the use of motivational methods such as goal setting and goal achievement.

Good technique is developed through the principles of skill teaching and learning. Reinforcement and correction are an integral and on going aspect of strength coaching as they allow for maintenance or

modification of good technique. The three part positive reinforcement system provided during or after a set has proven to be a most effective means of reinforcement correct, and/or modifying incorrect technical behaviour.

References:

1. Beginning coaching Level 1 Coaching Manual. Australian Coaching Council, Belconnen, ACT, 1990.
2. Wills, R. in Level 1 Powerlifting Coaching Manual. Powerlifting Australia, Sth Yarra, VIC. 1994.

**Table 1.** Verbal reinforce cues appropriate for coaching or correcting technique in strength training exercises

Exercise	Starting position	Eccentric	Concentric
Squat	"Butt in, chest up, deep breath"	"Butt back' onto heels"	"Hips Through"
Front Squat	"Butt in, elbows up, deep breath"	"Elbows up/ onto heels"	"Hips Through"
Bench Press	"Tight, chest up, shoulders back"	"Control the Weight"	"Blast, to eyes"
Power shrug	"Chest up, elbows out, back flat"	"Butt back"	"Explode up/ hip drive"
Push press	"Butt in, torso tight, elbows up"	"Quick dip"	"Up and back" (i.e. push)

**Table 2.** An example of the use of verbal reinforcers by the coach whilst coaching a set of squats for a beginner level athlete. Each of the coach's statements contains simple praise, a positive reinforce concerning a good aspect of performance and a corrective reinforce if an error in technique occurred.

Beginner		
Rep #	Athlete performance	Coach says during or immediately after the rep
1.	Knees moved forward	"Good rep...Good hip drive..push hips back first"
2.	Good technique	"Excellent...hips & knees were perfect...do it again"
3.	Good technique	"That is it...keep it going"
4.	Chest not high enough	"That's OK...nice hip drive...keep the chest up"
5.	Knees move in slightly	"Great stuff....good chest position..keep knees out"
6.	Chest not high enough	"Super...great strength...chest up deep breath"
7.	Chest hot high enough	Yes...good stuff..c'mon chest up, huge breath"
8.	Butt not held in & tight	"OK...nice and strong..got to keep the but in"
<p>After the set "That was a good set, nice and strong. Your hip drive was excellent. Near the end of the set your chest wasn't getting up high enough, probably as you were fatigued. Next set we will really concentrate on keeping the chest up and the butt in tight during the set so that we can blast faster out of the bottom</p>		

**Table 3.** An example of the use of verbal reinforcers by the coach whilst coaching a set of squats for an intermediate level athlete. Each of the coach's statements contains simple praise, a positive reinforcer concerning a good aspect of performance and a corrective reinforcer if an error in technique occurred.

Rep #	Athletes Performance	Intermediate
		Coach says during or immediately after the rep
	Setting up	"C'mon...tight & strong...chest...hips"
1.	Good technique	"Great"
2.	Good, but chest dropped slightly	"Good...strong...chest up"
3.	Good technique	"Great rep...blasting it"
4.	Wobbly at bottom	"OK, good recovery....tight...tight...tight"
5.	Good technique	"Excellent tight and controlled"

After the set. "Great stuff. Very strong out of the bottom. Focus on staying tight and getting your chest up every rep to make it perfect.

**Table 4.** Some basic premises concerning the influences of body shape or type upon the biomechanics of bench pressing

Technical Aspect	Most suited to	Rationale
Narrower grip	Female athletes	Weaker shoulders, stronger arms
	Beginner athletes	Weaker shoulders, stronger arms
	Short arm, barrel chest	Less stretch across shoulders
	Injured shoulders	Less strain upon A-C joint etc
Perpendicular grip	Intermediates	Optimal use of all muscles
Wide grip	Long arms, strong chest	Less tricep, decrease ROM
Elbows travelling in	Narrower grips	Optimal bar path, less joint rotation
Elbows travelling out	Wider grips	Optimal bar path, less joint rotation
Chest up, shoulders back	All athletes	Chest on stretch, less shoulder rotation at bottom of ROM
Feet on floor	All athletes	Most stability, less joint rotation
Feet in the air	Short arm, bit chest	Can increase ROM
Bar touches chest higher	Wide grip	Optimal bar path, less joint rotation
Bar touches nipple line	Perpendicular grip	Optimal bar path, less joint rotation
Bar touches below chest	Narrower grip	Optimal bar path, less joint rotation
Mainly vertical bar path	Wide Grip	Optimal bar path, maintains reduced lifting moment
Bar pushed slightly back	Perpendicular grip	Optimal bar path, reduces lifting moment about the shoulder
Bar pushes back markedly	Narrower grip	Optimal bar path, quickly reduced lifting moment about the shoulder