The Effect of Grip Width on Bench Press Performance

Loree L. Wagner, Sharon A. Evans, Joseph P. Weir, Terry J. Housh, and Glen O. Johnson

The purpose of this study was to determine the effects of grip width, chest depth, limb lengths, and bar path on the performance of a maximal bench press. Subjects were 24 experienced male weight trainers. Bench press performance was assessed at six different grip widths (G1–G6). Repeated-measures ANOVA with Tukey post hoc comparisons revealed that bench press strength values at the two moderate grip widths (G3 and G4) were significantly greater than either the narrow or wide grip widths. First-order partial correlations showed no significant relationship between strength values and anthropometric variables when adjusted for differences in body weight. Standard two-dimensional cinematographic procedures were used to film a subsample \( (n=6) \) while bench pressing using G1, G3, and G6. The results of the statistical comparisons of bar path indicated that as grip width increased, the horizontal and vertical distance from the bar to the shoulder decreased.

Many biomechanical and anthropometric relationships have been examined to determine their relationship to bench press performance. Although the activity of the anterior deltoid, triceps brachii, and pectoralis major muscles during the bench press movement has been quantified through electromyography (Elliott, Wilson, & Kerr, 1989; McLaughlin, 1984; McLaughlin & Madsen, 1984; Rosentswieg, Hinson, & Ridgway, 1975), their relative contributions may depend on the width of the subject’s grip on the bar (McLaughlin, 1984). Madsen and McLaughlin (1984) suggested that the geometry of the movement of the bar was an important factor in successful bench press performance. As elite lifters typically used a wider grip on the bar compared to novice lifters, they were able to move the bar in a path that was significantly closer to the shoulder axis (Madsen & McLaughlin, 1984), which decreased the moment of force about the shoulder. Lander, Bates, Sawhill, and Hamill (1985) identified a “sticking region” in the bench press and defined it as the portion of the ascent phase of the lift where the instantaneous vertical forces the subject applied to the bar were less than the weight of the bar, and was the portion of the lift where failure was most likely to occur. Horizontal displacement of the bar was characteristic of the
sticking region which decreased the moment arm of the instantaneous force about the shoulder axis. This horizontal displacement of the bar reduced the torque that the subjects had to exert to move the bar through the sticking region (Elliott et al., 1989).

Hortobagyi, Katch, and LaChance (1989) examined the influence of factors such as stature and body weight on maximal bench press performance; however, the contribution of individual differences in arm length, forearm length, and chest depth have not been examined. Long limbs should be a disadvantage for a maximal bench press, due to the increased length of the lever arm and the higher resistance torque that must be overcome. Given that arm length and grip spacing are fixed during a bench press movement, chest depth may also be an important factor. A larger chest depth would result in a shorter distance in which the bar must be moved, therefore less mechanical work would need to be performed (Algra, 1982; McLaughlin, 1984).

United States Powerlifting Federation (USPF) rules (Foster, 1987) dictate that the spacing of the hands on the bar cannot exceed 81 cm between the forefingers of each hand. Madsen and McLaughlin (1984), however, having observed the wider grip used by elite lifters, suggested that the optimal grip may be wider than the 81-cm limit set by the USPF (Foster, 1987). This is inconsistent with Lander et al. (1985), who recommended the use of a moderate grip (90° flexion at the elbow). Thus, definitive data regarding the most appropriate grip width for the bench press exercise is not available. The purpose of this investigation was to determine the effects of grip width, chest depth, limb lengths, and bar path on the performance of a maximal bench press.

**Methods**

**Subjects**

Twenty-four male college students (M age ± SD = 21.46 ± 2.64 yrs) volunteered for this investigation. The subjects had a minimum of 2 years bench pressing experience and could bench press at least 125% of their body weight. The study was approved by the Institutional Review Board for Human Subjects, and all subjects signed an informed consent form before taking part in this investigation. Prior to any testing, the anthropometric measurements were determined using the procedures described in Wilmore et al. (1988) and in Martin, Lindsay-Carter, Hendy, and Malina (1988).

**Testing Protocol**

Prior to performing any bench press attempts, the grip width normally used by the subject was recorded. The subjects then performed a series of bench presses to determine their 1-RM load. They performed a maximal bench press on six occasions, separated by at least 48 hours. The grip width during each visit was randomly determined based on 95 (grip width 1 = G1), 130 (G2), 165 (G3), 200 (G4), 235 (G5), or 270 (G6) percent of biacromial breadth. All attempts were judged by a certified (USPF) referee. The sequence of events in the bench press were as follows: The subject lay supine with head and trunk extended on the bench and feet flat on the floor. He then received a lift-off from a spotter, after which he lowered the bar to his chest. The referee’s signal was given when
the bar was motionless on the chest. After the signal, the bar was pressed vertically to straight-arm’s length and held motionless until the referee’s signal to replace the bar (Foster, 1987).

All subjects performed two warm-up sets of 8 repetitions at 50% of 1-RM, additional warm-up sets were allowed if requested. The first lift that was attempted represented approximately 80% of the subject’s estimated maximum. Three to seven attempts were required to determine each subject’s 1-RM within 22.26 N of his true maximum. Subjects rested at least 2 minutes between each attempt. They were not aware of the weight on the bar at any time during the testing.

**Filming Procedures**

In order to examine possible biomechanical factors that may have accounted for differences in bench press strength at various grip widths, a subsample \((n = 6)\) was filmed while bench pressing using G1, G3, and G6. Only trials of the maximal lifts were analyzed for this study.

A motor-driven 16-mm camera fitted with a 15-150-mm focal length lens was used to record all lifts. The camera was positioned approximately 7 m from the bench with the optical axis perpendicular to the sagittal plane. The film speed was set at 40 Hz. Film speed was calibrated using an internal timing light generator set at a pulse rate of 10 Hz. Dots of 1 cm diameter were applied to the lateral portion of the acromion process of the left scapula, which was then taken as the shoulder joint and at the center of the end of the bar facing the camera.

Each frame was digitized using a Numonics graphics calculator interfaced with an IBM compatible computer. The raw x-y coordinates were smoothed using a second-order Butterworth digital filter. The bar path was determined relative to the shoulder. Actual bar movements were calculated by using a linear multiplier standard which was filmed while positioned at the left end of the bar and in the bar’s plane of motion. Vertical velocities and accelerations were calculated via first finite difference calculus (Miller & Nelson, 1973). The instantaneous vertical component of the force exerted by the subject on the bar was calculated using the formula

\[
F_y = m \cdot a_y + w
\]

where \(m\) = mass of the bar, \(a_y\) = vertical component of the bar acceleration, and \(w\) = weight of the bar. The torque at the shoulder was obtained by calculating the product of the instantaneous vertical component of force exerted by the subject and the horizontal distance from the bar to the shoulder axis.

In order to locate specific points throughout the ascending phase of the bench press, the following six “instants” in the motion of the bar as initially defined by Madsen and McLaughlin (1984) were determined:

1. CHST—beginning of the ascending phase when the bar is on the chest;
2. MXAR—first local maximum of the vertical acceleration during the ascent phase;
3. MXVR—first local maximum of the vertical velocity during the ascent phase;
4. MNAR—first local minimum of the vertical acceleration during the ascent phase;
5. MNVR—first local minimum of the vertical velocity during the ascent phase; and
6. END—the end of the lift, with arms fully extended.

**Analysis of Data**

First-order partial correlations were used to examine the relationships among the bench press strength values at the various grip widths and anthropometric characteristics (forearm length, chest depth, and arm length) adjusting for differences in body weight. Repeated-measures ANOVA with Tukey post hoc comparisons were used to locate significant mean differences between the bench press strength values for the various grip widths, and to compare the position of the bar at selected instants throughout the lift. A probability level of $p<0.05$ was selected as the level of significance for all analyses.

**Results and Discussion**

Previous investigations have indicated that maximal bench press performance is influenced by biomechanical and anthropometric factors including bar path, grip width, chest depth, and limb length (Elliott et al., 1989; Harman, 1984; McLaughlin, 1984; Rosentswieg et al., 1975; Wilson, Elliott, & Kerr, 1989). The importance of these factors in experienced weight trainers has not been fully quantified, however.

**Bench Press Strength Values at Different Grip Widths**

The descriptive characteristics of the subjects are presented in Table 1. There were significant differences in bench press strength between the six grip widths, $F(5,115)=16.09, p<.05$. Figure 1 shows the bench press strength values at the various grip widths. Tukey post hoc comparisons were used to locate the significant differences between means. In general the subjects were stronger at moderate grip widths (G3 and G4) than at narrow (G1 and G2) or wide grip widths (G5 and G6). G3 and G4 were significantly greater than G1, G5, and G6. G4 was also significantly greater than G2. G2 was significantly greater than G1. Bench press strength at G1 and G2 were not significantly different from bench press strength at G5 and G6. The mean grip widths for G3 and G4 were 66.70 cm (165% of biacromial breadth) and 80.85 cm (200% of biacromial breadth), respectively. The subjects’ normal mean grip width corresponded to 76.52 cm (189% of biacromial breadth).

McLaughlin (1985) suggested that a wide grip on the bar is most advantageous for bench press performance because it allows for maximal involvement of the pectoralis major muscle. When compared to a narrow grip width, a wide grip also causes the bar to start and finish in a position that is closer to the chest, thus reducing the distance the bar must move (Madsen & McLaughlin, 1984). Lander et al. (1985) suggested, however, that a moderate grip (90° arm-to-forearm angle) is more effective for maximal bench press performance than a narrow grip (80° arm-to-forearm angle and 45° arm-to-trunk angle) or wide grip (98° arm-to-forearm angle and 90° arm-to-trunk angle).

Theoretically, the moderate grip width allows for explosive force production off the chest at the beginning of the ascent, due to the small arm-to-trunk angle,
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Table 1
Descriptive Characteristics of the Subjects (n = 24)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>21.46</td>
<td>2.64</td>
<td>19.00 – 27.00</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177.67</td>
<td>5.28</td>
<td>170.18 – 193.04</td>
</tr>
<tr>
<td>Weight (N)</td>
<td>836.44</td>
<td>106.41</td>
<td>686.39 – 1114.57</td>
</tr>
<tr>
<td>Biacromial breadth (cm)</td>
<td>40.44</td>
<td>1.22</td>
<td>37.80 – 42.80</td>
</tr>
<tr>
<td>Chest depth (cm)</td>
<td>21.70</td>
<td>1.57</td>
<td>19.50 – 24.70</td>
</tr>
<tr>
<td>Arm length (cm)</td>
<td>36.93</td>
<td>1.64</td>
<td>34.10 – 41.20</td>
</tr>
<tr>
<td>Forearm length (cm)</td>
<td>29.39</td>
<td>1.41</td>
<td>27.10 – 31.50</td>
</tr>
<tr>
<td>Strength at 95% biacromial breadth (N)</td>
<td>1098.19</td>
<td>137.10</td>
<td>823.00 – 1312.27</td>
</tr>
<tr>
<td>Strength at 130% biacromial breadth (N)</td>
<td>1134.38</td>
<td>151.91</td>
<td>845.17 – 1379.06</td>
</tr>
<tr>
<td>Strength at 165% biacromial breadth (N)</td>
<td>1165.87</td>
<td>154.66</td>
<td>823.00 – 1423.49</td>
</tr>
<tr>
<td>Strength at 200% biacromial breadth (N)</td>
<td>1176.06</td>
<td>165.15</td>
<td>845.17 – 1468.01</td>
</tr>
<tr>
<td>Strength at 235% biacromial breadth (N)</td>
<td>1130.65</td>
<td>151.81</td>
<td>823.00 – 1401.22</td>
</tr>
<tr>
<td>Strength at 270% biacromial breadth (N)</td>
<td>1101.91</td>
<td>153.28</td>
<td>823.00 – 1334.54</td>
</tr>
<tr>
<td>% Biacromial breadth at normal grip</td>
<td>189.22</td>
<td>35.29</td>
<td>152.08 – 207.72</td>
</tr>
</tbody>
</table>

and there is a substantial contribution from the pectoralis major muscle throughout the movement, due to the increasing arm-to-trunk angle up to 90° (Lander et al., 1985). Interestingly, McLaughlin (1985) recommended medially rotating the arms at the sticking point to utilize the additional contribution (in addition to the pectoralis major) of the triceps muscle. Thus there is some disagreement regarding the most advantageous path for the elbow during the bench press exercise.

The results of the present study demonstrated, however, that a moderate grip width (G3 and G4) resulted in significantly greater bench press performance than the narrow (G1) or wide grips (G5 and G6). It should be recognized that McLaughlin’s (1985) comments were concerned with expert lifters while the subjects in the present investigation were experienced (minimum of 2 years bench press experience) but were not elite competitors.

In addition to mechanical parameters, the contribution of training factors may be important to bench press performance. The strongest grip widths (G3 and G4) corresponded to 165 and 200% of biacromial breadth, respectively. The normal grip width of the subjects was 189.58% of biacromial breadth, which was similar to G4, the strongest grip width. Thus the greatest strength tended to occur at the grip closest to the subjects’ normal training position, therefore training specificity may help explain the differences in strength between grip widths.

The first-order partial correlations between bench press strength and the anthropometric variables at the various grip widths, when adjusted for differences
in body weight, were not significant. The range of first-order partial correlation values for chest depth was -.07 to .14, for arm length -.26 to -.34, and for forearm length -.24 to -.30, indicating that these variables do not influence bench press performance.

It has generally been accepted that anthropometric characteristics contribute to bench press performance (Algra, 1982; McLaughlin, 1985). McLaughlin (1985) suggested that world class weightlifters with large chests and short arms have an advantage in bench press performance because the bar has less distance to travel for a successful attempt. However, the results of the present study...
sugest that other factors such as muscle mass, bar path, arm-trunk angle, arm-forearm angle, and training experience contribute to better bench press performance.

McLaughlin and Madsen (1984) have suggested that for large subjects the optimal grip width may be wider than the 81-cm limit set by the USPF (Foster, 1987). The findings of the present study did not support this contention, as none of the subjects lifted more at G5 or G6 than at G3 or G4.

**Bar Path at Different Grip Widths**

The bar positions for G1, G3, and G6 for the ascending phase of the lift are illustrated in Figure 2. The bar path during both the descending and ascending phases differed for the three grip conditions. In both phases of the lift there was an inverse relationship between grip width and the distance of the bar from the shoulder. As grip width increased, the horizontal and vertical distances of the bar from the shoulder axis decreased. The decrease in distance resulted in a decrease in the moment of force about the shoulder axis at five of the six instants in the ascent phase of the lift (Figure 3).

![Figure 2](image)

Figure 2 — Mean bar path—ascend phase. Instants are: CHST (1), MXAR (2), MXVR (3), MNAR (4), MNVR (5), and END (6).
Figure 3 — Bench press—max lifts. Torque about shoulder axis (mean values).

Table 2
Bar Position Data and Statistical Comparisons

<table>
<thead>
<tr>
<th>Grip</th>
<th>1</th>
<th>3</th>
<th>6</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Horizontal distance (m) from shoulder to bar at</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MXAR</td>
<td>0.200</td>
<td>0.045</td>
<td>0.156</td>
<td>0.035</td>
</tr>
<tr>
<td>MXVR</td>
<td>0.198</td>
<td>0.047</td>
<td>0.150</td>
<td>0.038</td>
</tr>
<tr>
<td>MNAR</td>
<td>0.184</td>
<td>0.054</td>
<td>0.144</td>
<td>0.035</td>
</tr>
<tr>
<td>MNVR</td>
<td>0.173</td>
<td>0.053</td>
<td>0.126</td>
<td>0.035</td>
</tr>
<tr>
<td>Vertical distance (m) from shoulder to bar at</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MXAR</td>
<td>0.127</td>
<td>0.064</td>
<td>0.145</td>
<td>0.097</td>
</tr>
<tr>
<td>MXVR</td>
<td>0.161</td>
<td>0.048</td>
<td>0.183</td>
<td>0.085</td>
</tr>
<tr>
<td>MNAR</td>
<td>0.227</td>
<td>0.082</td>
<td>0.209</td>
<td>0.075</td>
</tr>
<tr>
<td>MNVR</td>
<td>0.282</td>
<td>0.072</td>
<td>0.243</td>
<td>0.065</td>
</tr>
</tbody>
</table>

Values are mean ± SD.
Statistically significant comparisons are indicated by * (p < 0.05).
Comparisons are: A, G1 vs. G3; B, G1 vs. G6; C, G3 vs. G6.

MXAR was the only instant where a decrease in the torque across grips was not evident. At MXAR, the moment of force about the shoulder axis was greater for G3 than for G1. The moment of force about the shoulder for G6 was lower than for G3, although the subjects could lift 6.4% more weight when using G3 (M = 1230.61 N ± 182.13) than when using G6 (M = 1156.48 ± 156.63). These findings suggest that the moment of force about the shoulder axis was not
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A critical factor in the difference in bench press strength at the three grips. The data from the present study support the findings of Madsen and McLaughlin (1984), who found no significant difference in the moment about the shoulder axis between expert and novice lifters.

The data from the statistical comparisons are presented in Table 2. The results of the repeated-measures ANOVA procedures indicated that 9 of the 10 statistically significant comparisons occurred during MXVR, MNAR, and MNVR, which delimit the sticking region (Lander et al., 1985) with the MNAR denoting the sticking point (Madsen & McLaughlin, 1984). In general, the results of the statistical analyses support the visual description of the bar paths, with the bar being significantly closer to the shoulder axis as grip width increased. An exception to this trend was noted in the comparison of the point signifying the beginning of the sticking region, MXVR. The sticking region began at a significantly higher point for G3 as compared to G6. Further examination of the sticking region indicated that this portion of the lift encompassed a shorter percentage of the ascent phase for G3 (11.4%) than for either G1 (17.3%) or G6 (22.5%).

In summary, the results of this investigation indicated that grip width affects maximal bench press performance in experienced male weight lifters. However, when adjusted for differences in body weight, there were no significant relationships between bench press performance and arm length, forearm length, or chest depth. Examination of the bar path at different grip widths revealed a decrease in the distance of the bar from the shoulder as the grip width increased. The increase in grip width was accompanied by a decrease in the moment of force about the shoulder axis. Also, for the middle grip width (G3), the sticking region was found to occur at a greater vertical distance from the shoulder axis and lasted for a smaller percentage of the ascent phase than for either the narrower (G1) or wider (G6) grip widths.

References


