

Research article

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LOW COMPRESSION TENNIS BALLS AND SKILL DEVELOPMENT

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ABSTRACT

Coaching aims to improve player performance and coaches have a number of coaching methods and strategies they use to enhance this process. If new methods and ideas can be determined to improve player performance they will change coaching practices and processes. This study investigated the effects of using low compression balls (LCBs) during coaching sessions with beginning tennis players. In order to assess the effectiveness of LCBs on skill learning the study employed a quasi-experimental design supported by qualitative and descriptive data. Beginner tennis players took part in coaching sessions, one group using the LCBs while the other group used standard tennis balls. Both groups were administered a skills test at the beginning of a series of coaching sessions and again at the end. A statistical investigation of the difference between pre and post-test results was carried out to determine the effect of LCBs on skill learning. Additional qualitative data was obtained through interviews, video capture and the use of performance analysis of typical coaching sessions for each group. The skill test results indicated no difference in skill learning when comparing beginners using the LCBs to those using the standard balls. Coaches reported that the LCBs appeared to have a positive effect on technique development, including aspects of technique that are related to improving power of the shot. Additional benefits were that rallies went on longer and more opportunity for positive reinforcement. In order to provide a more conclusive answer to the effects of LCBs on skill learning and technique development recommendations for future research were established including a more controlled experimental environment and larger sample sizes across a longer period of time.

KEY WORDS: Tennis, low compression balls, coaching.

INTRODUCTION

One aim of a tennis coach is to improve player performance, and coaches will have a number of coaching methods and strategies they can employ to enhance this process. In addition, the knowledge base that underpins the coaching process is constantly changing due to research in coaching methodology and individual experiences

(Fairweather, 1999). Such changes can take the form of alternative coaching styles and the use of new activities or equipment, amongst others. If new methods and ideas can be determined to improve player performance they can affect future coaching practice and enhance the coaching process. LCBs are typically used in modified versions of the game of tennis such as mini-tennis (Cayer and Elderton, 2002; LTA, 2005). The balls used in these versions

are variations of the standard ball that are softer, lighter and have lower bounce. The Lawn Tennis Association (LTA) also suggests that for very young players (4 - 8 years) the ball could be larger in order to make the game slower (LTA, 2005). While mini-tennis focuses on children the LTA suggest that beginners of all ages would benefit from playing the game with the slow moving balls, making skill learning easier.

Typically research involving tennis balls has used the standard type of ball or a standard ball that was modified by the researcher (Haake et al., 2003; Knudson, 1993; Mehta and Pallis, 2001). Recently the ITF (International Tennis Federation) have modified tennis ball specifications to include a faster (type 1) and slower, oversized (type 3) ball, to accompany the standard medium speed (type 2) ball which has the same ITF specifications that existed prior to 2000 (ITF, 2005). The new balls were developed in order to provide a greater degree of consistency to the game, the slowest ball to be used on fast courts the fastest ball on slow courts (ITF, 2005). Such changes have led to research on the effects of the new balls (particularly type 3). Metha and Pallis (2001) demonstrated that the larger cross-sectional area of a type 3 ball (approx. 6% bigger than type 1/2) increased drag on the ball, increasing the ball's flight time, which slows down the game. Research also suggests that the type 3 ball has the potential to change characteristics of game play, the type 3 ball having been shown to lead to less physiological strain and increased accuracy on a tennis skills test compared to the type 2 ball (Cooke and Davey, 2005). Cooke and Davey suggested that the improved accuracy of ground strokes with the type 3 ball may be beneficial to players with limited technical skills, such as those in the early stages of learning.

There are many dimensions to the coaching process, one important aspect being the development of skilled performance in players. As a result research has been conducted into the theory and practice of the coaching process aimed at improving skill learning, leading to recommendations for best coaching practice (Hodges and Franks, 2002; Schmidt and Lee, 1999). Challenges to the traditional style of coaching have led to the development of the game-based approach to coaching (Thorpe and Bunker, 1982). The success of this new method resulting in Tennis Coaches Australia (TCA) adopting the game-based approach to coaching as their preferred model (TCA, 2002). The use of non-traditional methods have also been investigated in younger players, where a series of pre-tennis activities using mini-tennis equipment led to improvements in

fundamental motor skill acquisition in 5 year olds. This suggests that such improvements would ease the transition to learning specialist tennis skills (Quezada et al., 2000). In addition to modifications of coaching style, many researchers have investigated the use of new techniques or modified equipment on skill acquisition. Focusing on tennis, the types of techniques investigated include the effects of visualisation strategies and aids to performance as well as player reaction or movement time when playing with the larger type 3 ball (Andrew et al., 2003; Singer et al., 2001).

The purpose of this study was to investigate the effectiveness of LCBs on skill learning in beginners participating in an eight-week tennis coaching programme. Specifically, we investigated the effects of using low compression balls (LCBs) during regular coaching sessions on skill learning for beginning tennis players.

METHODS

Beginner tennis players took part in coaching sessions, one group using the LCBs while the other group used conventional (standard) balls. Both groups were administered a skills test at the beginning of a series of eight coaching sessions (pre-test) and again at the end (post-test). A statistical investigation of the difference between pre and post-test results was carried out to determine the effect of LCBs on skill learning. Additional qualitative data was obtained through interviews, video capture and the use of performance analysis software to analyse typical coaching sessions for each group. These multiple methods of data collection allowed for triangulation of data.

Fourteen boys and girls aged 5-11 years volunteered to participate in the study, they were members of a weekly beginners' class at a private tennis centre located in New South Wales. The participants were classified as beginners by the head coach and then self-selected into coaching groups, these groups were randomly assigned to an experimental or control condition. The experimental group used LCBs and the control group used standard balls. Information regarding demographics of each group is provided in Table 1. The beginners coaching programme was developed and overseen by the head coach, a level 2 accredited tennis coach with 26 years experience. The coaches responsible for delivering the sessions were all employees of the tennis centre. The coaching programme was consistent for both groups, in terms of strokes, drills and activities so that the coaching content and time was the same for both groups throughout the study.

Table 1. Age, gender and previous experience of participants by group. Data are means (\pm SD).

Group	n	Age (yrs)	Gender	Prev.Experience (yrs)
LCB	6	6.67 (1.03)	Male = 4 Female = 2	.50 (.42)
Standard	8	9.38 (1.19)	Male = 6 Female = 2	1.06 (.72)

In order to describe the two types of ball used in the study, three LCBs and standard balls were randomly selected and their mass and size recorded. The LCB group used low compression balls that were softer, lighter and similar in size to the standard balls used in the study (Table 2).

Table 2. Mass and diameter of LCB and standard ball. Data are means \pm SD.

Tennis Ball	n	Mass (g)	Diameter (mm)
LCB	3	46.08 (.69)	73 (0)
Standard	3	57.58 (.16)	72 (0)

It is recommended that young children play tennis with a shorter, lighter racquet than adults (Cassell and McGrath, 1999; Harding, 1991). In this study children performed their skills test using a Pro Kennex Champ Ace Junior racquet suitable for their age (Cooper, 2005), all racquets being the same model. The participants underwent a traditional coaching programme, aimed primarily at introducing and developing forehand, backhand and serving skills. The sessions typically contained a warm up, drills, modified games and a cool down. The sessions took place on an Astroturf court with regulation height nets. Each group attended one coaching session a week for eight weeks, sessions lasted for one hour.

A skill test was administered to each participant independently to establish performance levels prior to the study (pre test) and after the period of coaching (post test). The test was developed specifically for the study, in line with the coaching programme the three items tested were the forehand, backhand and serve. A review of the literature on existing skill tests and consideration of the participants' ability, learning context and time

available for testing contributed to the development of the skill test, specific to the game of tennis. Skill test data was collected at the same venue as the coaching sessions. The pre-test occurring during week one and the post-test during week eight. Prior to the first test session age, gender, previous playing experience and hand dominance were recorded for each participant. Subjects were tested on the 3-item skills test. Verbal instruction and a demonstration were provided prior to testing each item, as well as indications of the scoring system. The same researcher administered all tests. For each participant, their score for each test trial on all three items (forehand, backhand and serve) were recorded and totalled (total test score). The score available for each trial ranged from 0-5, so a maximum total score of 90 could be achieved for the 3 test items across 6 trials each. For the skill test data, differences in total test scores between pre test and post test for both groups were analysed using the Kruskal-Wallis Test, in order to look for significant differences between groups. Skill test data was reported using group means and standard deviations. % difference calculations were used to compare a typical coaching session structure for each group.

A typical coaching session was videoed for both groups during week four of the coaching programme. The purpose of this was to obtain a record of a typical session and determine whether both groups spent similar amounts of time on each phase. A Macintosh OSX computer was linked to a digital 8 video camera so that the session content could be analysed using GameBreaker Performance Analysis Software (GPAS) and excel. The GPAS was customised to allow the frequency and duration of each phase of the session to be logged in order to determine the typical session structure and amount

Table 3. Events used to analyse a typical coaching sessions for both groups.

Event	Explanation
INTRODUCTION & WARM-UP	Start to end of introductory / warm up activity(s)
DRILL/SKILL PRACTICE	Activity where groups practice whole or part tennis skills not including warm-up / cool-down activities
MODIFIED GAME	Game based / competition based activity involving whole or part tennis skills not including warm-up / cool-down activities of drill/skill practices
COOL-DOWN & DEBRIEF	Concluding game, activity, group address/debrief
COLLECTING BALLS	Whole group involved in collecting balls
GROUP INSTRUCTION	Whole group stopped for coach instruction/demo.
INDIVIDUAL INSTRUCTION	Individual/small groups stop for instruction/demo.

Table 4. Percentage of time spent on each phase of session & difference scores for groups.

Event	% Time on each event (LCB Group)	% Time on each event (Standard Group)	% Difference
Intro & Warm-up	10.06	7.17	2.89
Drill/Skill Practice	27.9	32.58	-4.68
Modified Game	20.12	15.86	4.26
Cool-down/Debrief	7.06	6.54	0.52
Collecting Balls	9.27	5.35	3.92
Group Instruction	29.31	33.39	-4.08
Individual Instructn.	7.42	6.69	0.73

of time spent on each phase of the session for both groups. Initially these events were logged on site while the sessions were in progress and edited as necessary during the post session. Table 3 lists the events logged to establish typical session content using the GPAS.

The coaches responsible for overseeing or coaching the weekly sessions were interviewed individually. Each coach was asked questions regarding their coaching experience, their approach to the coaching sessions and their perceptions on the effect of the LCBs on skill learning for players in the LCB group compared to those in the standard ball group. Each interview lasted approximately 30 minutes. The interviews transcriptions were analysed to identify categories of response made by interviewees. Individual categories that related to the responses for each question were derived and the substantive statements assigned into one of these (Gillham, 2000), allow for summaries of key points.

RESULTS AND DISCUSSION

The results of session content analysis for a typical session, indicate that both groups were receiving similar content and amount of time spent on each activity. Table 4 indicates the percentage time each group spent on each phase of the session and how long participants were involved in collecting balls or being instructed by the coach.

Table 4 shows the difference in time for each group is less than 5% for all events, the absolute difference between groups for each event ranging from 0.52% to 4.68%. A difference of less than 5% is generally considered acceptable when comparing the differences between two groups (Hughes and Franks, 2004). Data presented only represents one session for each group and cannot generalise to all sessions. However, these results do give an indication of the similarity of activities that both

groups experienced throughout the study. In addition, the coaches strived to ensure that as many aspects of the session structure as possible was similar for both groups. A summary of the total skill test scores for pre and post tests and the difference scores (representing post-test score minus pre-test score) for each group is provided in Table 5.

A positive difference score indicates improvement on the skills test between pre and post test, the larger the score the greater the improvement. The results show that the LCB group had a larger mean difference score (11.33 ± 7.97) than the standard group (7.88 ± 15.11). The difference in pre and post test (total) scores for each group were compared using the Kruskal-Wallis test, to determine whether the difference between the groups was significant and could be attributed to using the LCBs during the coaching sessions. The results of the statistical analysis (Table 6) indicate that the difference between groups was not significant ($p > 0.05$). A non-significant result suggests that using the LCBs during beginners coaching sessions over an eight week period does not significantly increase performance on a skills test when compared to a group of beginners coached using standard balls.

Table 6. Results of statistical analysis of skill test difference scores (post test - pre test).

χ^2 statistic	df	Asymp Sig.	Test Significant
.038	1	.846	No

Analysis of Figure 1, shows that the LCB group had a much lower mean score for the pre-test than the standard group (Table 5), suggesting that there were differences between the skill level of the two groups at the start of the study. At the end of the study the LCB group still had the lowest performance scores but had improved the most

Table 5. Summary of skill test scores (total score) for both groups. Data are means (\pm SD).

Group	n	Pre Test Score	Post Test Score	Difference Score
LCB	6	15.67 (13.63)	27.00 (14.67)	11.33 (7.97)
Standard	8	43.88 (8.08)	51.75 (12.27)	7.88 (15.11)

(although not significantly), such a trend follows the observations of Boyle and Ackerman (2004) where the lower performers initially remain the lowest performers at the end of a period of skill acquisition but have shown the biggest gain in improvement.

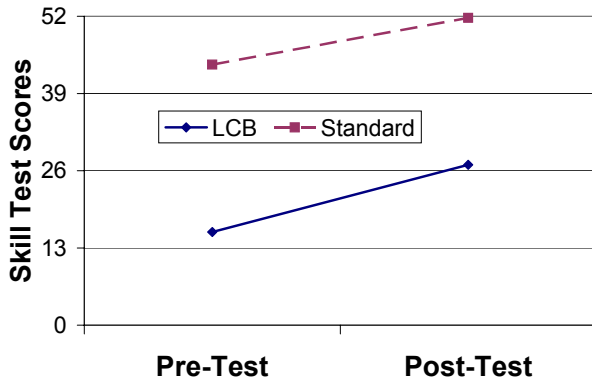


Figure 1. Mean skill test scores (total) for pre and post test for LCB and standard groups.

The initial differences in skill level between the two groups could have been influenced by the differing characteristics of the participants in both groups, such as age and previous experience (Table 1). Age has been linked to the stage of motor development a child is in (Gallahue and Ozmun, 1997). The mean age of the LCB group (6.67 ± 1.03 yrs) suggests that the majority of participants would still be developing their fundamental movement skills. The standard group, however, had a mean age of 9.38 ± 1.19 years, indicating that the majority of participants in that group are more likely to have refined their fundamental movement patterns and progressed to a more advanced phase of motor development where they are more capable of developing the skills needed to play tennis (Gallahue and Ozmun, 1997).

It is suggested in the literature that children who attempt to learn specialist movement skills before they have developed the mature form of the fundamental movement skills necessary to perform the specialised movement, may be hindered in their progress (Gallahue and Ozmun, 1997). Therefore, due to the mean age of the LCB group it is possible they had not refined their fundamental movement skills prior to commencement of this study, which could result in less capability for the LCB group to learn specialised tennis skills such as the backhand stroke. In addition, the standard group was shown to have had more previous tennis coaching (1.06 ± 0.72 yrs) than the LCB group (0.50 ± 0.42 yrs). Although the difference between groups was not significant the mean difference scores for the LCB group were slightly higher than for the standard

group (Table 5). Investigating the data by item it reveals that the LCB group showed the greatest improvement in the forehand stroke than any other, whereas the standard group showed the greatest improvement in the backhand score, both groups showed least improvement in the serve (Figure 2).

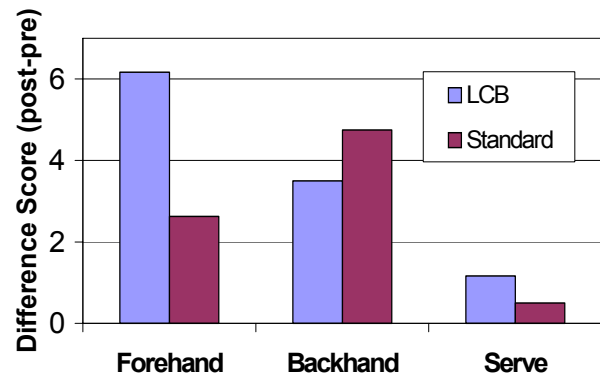


Figure 2. Mean skill test difference scores (pre - post test score) by item for each group.

The focus of the interviews was the approach to the coaching sessions by the coaches and the observed effects of the LCBs on the learners' performance. There was agreement between coaches that they had followed a similar programme, which involved a combination of traditional approaches to coaching with a contemporary style, including fun participation games. Additionally activities provided in the TCA coaching manual and from Tennis Australia (TA) seminars were included. To ensure consistency the head coach monitored the sessions, with regular feedback to the coaches.

Regarding effects of the LCBs on learners' performance the coaches felt that the LCBs had the most positive effects on complete novices and the youngest players. Coaches suggested that players were aided by the lower ball bounce if they had no experience playing with the standard balls. For players with previous experience, using the LCBs were reported to have a negative effect on their attitude as these players considered using the LCBs as taking a step backwards. One coach reported that for accomplished beginners their confidence went down initially although this did not seem to be a problem after a couple of weeks. There was general agreement between the coaches that even for the beginners with previous experience the LCBs were good for overall development, especially development of technique. A similar point was observed for the less experienced beginners where one of the coaches indicated that it was easier to teach them the correct technique of hitting from low to high as the LCBs bounce closer to waist height.

The advantages of the LCBs in allowing technique development in children is that they can be taught the correct style, such as stepping in and hitting the ball as well as hitting from low to high with the ball remaining in court. One coach suggested that teaching players to step in and hit when using the standard balls often resulted in the ball being hit out of court as players at this level are not capable of applying the appropriate spin to keep the ball in court. The LCBs were reported as having a positive effect as they allowed correct technique to be taught yet allow rallies to continue and in turn provide greater positive reinforcement to the players. No major gender differences regarding the effect of the LCBs on learning were reported. Whilst interviews with coaches pointed to the benefits of using LCBs for technique development, there was no evidence from this study to suggest that these benefits will transfer to playing with the standard balls.

CONCLUSIONS

The skill test results indicate there is no difference in skill learning when comparing beginners coached using the LCBs to those coached using the standard balls. The non-significant differences between groups could have also been affected by differences in mean age and previous experience characteristics of the groups and the relatively short amount of practice time between the initial and final skills test. The coaches' reported that the LCBs appeared to have a positive effect on correct technique development in beginners including aspects of technique that are related to improving the power of the shot without the ball going out of court as much as when coaching with the standard ball. Additional benefits were that rallies went on longer providing more playing time and more opportunity for positive reinforcement. In order to provide a more conclusive answer to the effects of LCBs on skill learning and technique development in beginners, recommendations for future research are suggested in the next section.

There were limitations imposed on this study that contributed to inconclusive results and these should be addressed in future research. Firstly, time and budget constraints determined the study had to be conducted within one school term, with the number of coaching sessions limited to 6x1 hour sessions between pre and post tests, limiting time for skill learning to take place. Future research would benefit from a longer period of coaching to ensure sufficient time for improvement, providing a more accurate assessment of LCB effect. Secondly, although participants were classified as attending

the 'beginners' class, there were differing ages and levels of experience between the groups. Ages and playing experience should be standardised across control and experimental groups. Finally, results and observations from this study would suggest a more controlled, longitudinal study would enhance understanding of the effects of LCBs on beginners' skill learning.

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KEY POINTS

- LCB may aid skill learning in tennis.
- Qualitative indicators.
- Statistical evidence not conclusive.
- Further studies of larger groups recommended.

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