Height variations in football shoes (cleats) for running backs and receivers may not alter ankle spatting effects in football field drills

By Peyton P. Faganel, Ty C. Drake, Angela R. Dahl-Miller, ATC and David S. Senchina, PhD
Drake University

Abstract:

Spatting is one option for increasing ankle support for football players. It is unknown how the effects of spatting may be influenced by the height of the football shoe (cleat). Nine young adult males (21.6 ± 1.8 yr., 180 ± 1.7 cm, 72.6 ± 2.4 kg) performed two football drills (60 yd. sprint and 25 yd. cutting drill) with their ankles taped and spatted, once in low-top and once in mid-top football cleats. Heart rate, performance time, and measures of foot comfort and stability were recorded for each drill. Four ankle range-of-motion (ROM) measurements (dorsiflexion, plantarflexion, talar eversion, talar inversion) were recorded for both conditions, plus additional control conditions. Subjects rated their feet as significantly more comfortable in the low-top compared to the mid-top ($p=0.015$). Although there were no significant differences in perceptions of stability, the average stability rating was higher for the mid-top. Expectedly, ankle ROM decreased in a statistically significant manner (all $p \leq 0.06$) with increasing layers on the ankle: barefoot > taped only > taped + shod > taped + shod + spatted. However, there were no significant differences in ROM by shoe height when ankles were either taped + shod + spatted or taped + shod. Heart rate and performance outcomes did not differ based on cleat. Despite the fact that the mid-top cleat covers the ankle malleolus, whereas the low-top cleat does not, it appears that shoe height influences perception but not performance or ROM when ankles are taped or taped and spatted.

Introduction

Football players take care in selecting their footwear, and different cleat models are marketed for different positions. In this paper, the word "cleat" will be used in the common or vernacular sense to refer to the entire shoe and not just the studs on the sole, which are technically also called "cleats" or "studs" or "spikes". Running backs and receivers usually choose a low- or mid-cut cleat, whereas linemen or linebackers usually choose a mid-cut (¾-cut) cleat. Lower-cut cleats are lighter weight, whereas higher-cut cleats provide more support.

The main reason why an athlete chooses a more supportive, higher-top shoe is to reduce the risk of or to stabilize pre-existing ankle sprains by limiting ankle range-of-motion (ROM). Early work suggested that athletes who wore high-top shoes did not experience lower ankle sprain rates compared to athletes wearing low-top shoes.[3,4] Subsequent work suggested that shoes with taller uppers may reduce sprain rates depending on loading forces and foot angle.[5,9,13] Most recent reviews conclude high-top shoes reduce ankle ROM and can reduce ankle sprain rates.[19,20] Most of these studies occurred within the context of basketball.

In addition to the cleat, football players often wear other ankle support measures such as tape jobs, spat jobs (additional tape jobs over the cleat and sock), or ankle braces. Standard taping and bracing restrict ROM and are effective at reducing the rates of or stabilizing pre-existing ankle sprains.[1,19] Also, a recent comprehensive review concluded that standard tape jobs, braces, and high-tops do not impact performance.[15] Much less is known about spatting. In terms of ROM, spatting or spatting + taping is more restrictive than taping alone, though there may be a loosening effect during exercise.[10,12,16,18] In terms of performance, spatting + taping has not been associated with declines in performance when compared to taping, but one study reported spatting + bracing induced larger performance losses than bracing alone.[2,12,16] In terms of athletes' perceptions, conditions for tape alone or brace alone were perceived as more comfortable than conditions involving spatting; for "stability," athletes either perceived spatted conditions were more stable or equivocal to other conditions.[12,18] It is not known whether the height of the cleat modifies the effects of spatting.

The purpose of this investigation was to determine if the height of football cleats typically used by running backs or receivers changed how athletes performed in football drills when their ankles were taped and spatted. Nine young adult males had their ankles taped and spatted in both low-top and mid-top football cleats in a balanced randomized crossover design. Subjects performed both a sprint and cutting drill in both conditions where performance time, footwork errors, heart rate, and perceptions of ankle comfort and stability were recorded.

Materials & Methods

Subject Characteristics

All procedures were approved by the Drake University Institutional Review Board (Drake IRB ID 2009-10031) prior to the commencement of the experiment, and all subjects gave written informed consent prior to participation. Subjects were included if they were male, between the ages of 18-35, and could safely and competently exercise in a size 11 football shoe. Subjects were excluded if they presented any physical conditions that precluded safe exercise, or if they had sustained an ankle injury within two years of the study. Nine young adult males participated. Subject characteristics were as follows, expressed as means ± standard error: age = 21.6 ± 1.8 yr., height = 180 ± 1.7 cm, mass = 72.6 ± 2.4 kg, body fat

Figure 1: Subject wearing low-top cleat (top) and mid-top cleat (bottom). The white tape mark indicates the ankle lateral malleolus.

percentage = 12.3 ± 0.9%, resting heart rate = 66.4 ± 4.1 beats per minute (bpm). For comparison to the football shoes used in the study, subjects were asked to bring their normal training shoes. The average mass of the subjects' training shoes was 364.6 ± 9.9 g. ROM was determined using a standard 12" goniometer (HPMS Inc.) with all measurements taken at rest and on the right ankle. The four measurements taken were dorsiflexion, plantarflexion, talar eversion, and talar inversion.

Shoes and Taping Regimens

The football shoe used in this study was a size 11 Nike Land Shark molded cleat. All shoes were brand new when the study began. Masses of the low-top and mid-top cleats were 439 g and 447 g, respectively. The low-top shoe does not cover the ankle lateral malleolus, whereas the mid-top shoe does (Fig. 1). All subjects completed the experiment in the same two pairs of shoes and were given identical socks to wear (BodyGlove Inc.) that extended midway up the leg. Ankle taping was performed directly on the ankle itself, whereas the spatting occurred over the ankle taping, sock, and cleat (Fig. 2). The same researcher (Faganel) did all the taping. For the ankle taping, both of the subjects' ankles were sprayed with an adhesive (Tuf-Skin Tape Adherent; Cramer Products, Inc.) over which were placed two heel-and-lace pads (3×3-in. cushioned pad and Skin-Lube lubricating ointment, both Cramer Products Inc.). A single layer of underwrap was applied (2 ¾" prewrap; Mueller Sports Medicine Inc.) Standard ½" athletic tape (Johnson & Johnson, Inc.) was used with half-width overlap between adjacent tape strips. The taping procedure is described in detail elsewhere, but consisted of anchor strips, stirrup strips, alternating medial and lateral heel-locks, figure-8's, and finishing strips.[12] Spatting methodology was identical to ankle taping except the following: no underwrap/spray adhesive was used because the tape was applied directly over the cleat/sock, tape strips were adjusted when going under the cleat so that the tips of the studs were left uncovered, and an extra volume of tape was necessary given the added size of all coverings atop the ankle.

Procedures

Initial anthropometric measurements were taken in the laboratory. Height and weight were determined by a physician's scale (Health-o-Meter Professional), and body composition was determined via bioelectrical impedance analysis, or BIA (BodyStat Inc.). Subjects were fitted with a heart rate monitor worn directly against the chest (F6 model; Polar Electro Oy). Football drills were performed on artificial turf ("Field Turf" 2nd generation; Tarkett Sports Co.) at the Drake University outdoor football stadium.

Prior to exercise, subjects were allowed up to five minutes to warm up on the turf in their normal training shoes. Subjects were asked to remove their shoes and socks. Goniometry was performed barefoot, and again after both of their ankles had been taped. The same researcher (Drake) performed all the goniometry. Subjects were given a pair of socks and either the low-top or the mid-top football cleat to wear (order randomized). Goniometry was repeated, both of the subjects' ankles were spatted, and goniometry was again performed. Subjects completed both football drills (described below) then the spatting and cleat were removed. Subjects were then given the other football shoe, goniometry was performed, both of the subjects' ankles were spatted a second time, then goniometry was repeated. Thus, goniometry was performed on six different ankle conditions: (1) barefoot, (2) tape-only, (3) tape + low-top, (4) tape + low-top + spat, (5) tape + mid-top, and (6) tape + mid-top + spat. However, exercise was performed in only two conditions: tape + low-top + spat and tape + mid-top + spat. Only two conditions were tested during exercise to minimize both physical and psychological fatigue.

The sprint drill was always conducted before the cutting drill. For the sprint drill, a 60-yd. distance was measured and subjects ran the distance as fast as possible. For the cutting drill, ten disc cones (Adidas Inc.) were arranged on the ground in two columns of five cones each such that they alternated. Subjects were asked to run ("cut") from the first cone in column A, to the first cone in column B, to the second cone in column A, and so forth, to the end of the series. Cones within a column were spaced 5-yd. from each other. The distance between the two columns was also 5-yd., but cones within the two columns were staggered such that the "forward distance" from a cone in one column to the cone on the other column was 2.5-yd. The total "forward distance" of the cutting drill was 25-yd., even though the subject ran over twice that distance within the drill.

After completing each drill, time-to-completion and heart rate were recorded. Accuracy measures (number of correct contacts and number of misses) were also recorded for the cutting drill. Subjects were presented with two separate 10-cm visual analogue scales after each drill for perception of comfort and stability. Each scale consisted of a 10-cm line anchored with two directives on either end. For the comfort scale, the anchor phrases were "least comfortable imaginable," [sic] and ""most comfortable imaginable," [sic] whereas for the stability

Figure 2: Ankle taping (top) and ankle spatting (bottom) techniques.

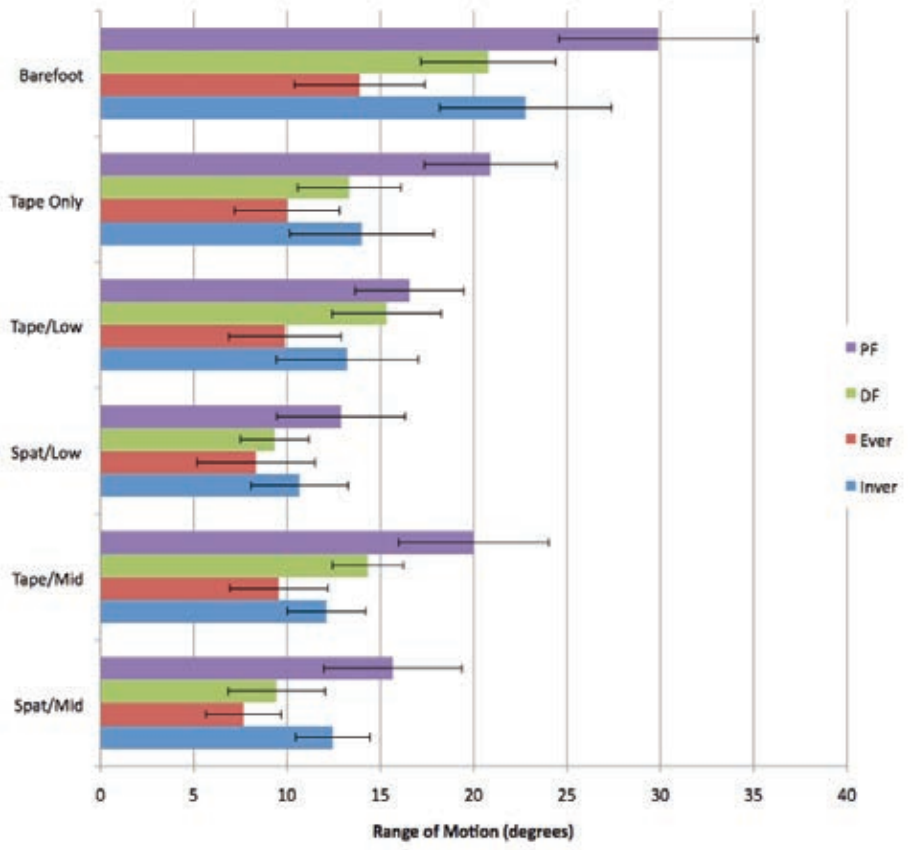

Figure 3: Ankle ROM (as determined by manual goniometry) for all conditions tested in this study. "Low" and "mid" indicate data from the low- and mid-top football cleats, respectively. "Tape" indicates the ankle was taped, "Spat" indicates the ankle was spatted in addition to being taped. For ROM measurements: PF = plantarflexion, DF = dorsiflexion, Ever = talar eversion, Inver = talar inversion.

scale, the anchor phrases are the same only the word "comfortable" was replaced with "stable." Subjects were asked to mark a vertical line along the continuum based on how their ankle felt after performing each drill in comparison to wearing an "ideal football shoe."

Statistics

Univariate ANOVAs were performed using PASW 19.0 (SPSS, Inc./IBM) with significance defined as $p<0.05$, and a trend defined as $0.05<p<0.1$. For ROM, independent factors included test performed (the four goniometry measurements) and ankle condition (the six ankle conditions), with degrees of motion being the dependent factor. For perception scales, independent factors included the drill (sprint or cutting) and the ankle condition (tape + low-top + spat or tape + mid-top + spat), with comfort or stability rating serving as the dependent variable. The ANOVAs for the performance parameters were structured similar to the perception scale ANOVAs, only a separate ANOVA was performed with each performance outcome serving as a distinct dependent variable. Whenever significant main effects were uncovered (such as a main effect of test or a main effect of ankle condition in the case of ROM), follow-up post-hoc pairwise comparisons (using LSD) were conducted.

Results

Range-of-Motion

Expectedly, there was a significant difference in absolute ROM for all four ROM tests (dorsiflexion, plantarflexion, talar eversion, talar inversion; Fig. 3) used in this study (main effect $p<0.001$). There was also a significant difference in ROM between the six ankle conditions (main effect $p<0.001$). Pairwise comparisons between the six ankle conditions revealed that the barefoot condition had much greater ROM when compared to all five other ankle conditions (all ≤ 0.001).

In terms of the effects of the football cleat itself on ROM, there were no significant differences between ROM in the tape-only condition compared to tape + low-top or tape + mid-top. Similarly, no significant differences in ROM were found when tape + low-top was compared to tape + mid-top, nor when tape + low-top + spat was compared to tape + mid-top + spat. Taken together, these results indicate that the height of the football shoe itself does not alter ROM in any comparisons, despite the fact that the low-top shoe does not cover the ankle malleolus, whereas the mid-top shoe does.

In terms of the effects of taping regimens, there was a significant difference when the tape-only condition was compared to tape + low-top + spat ($p=0.011$) and there was a trend towards a significant difference when tape-only was compared to tape + mid-top + spat ($p=0.057$). The tape-only condition was associated with greater ROM in both instances. There was significantly greater ROM for tape + low-top compared to tape + low-top + spat ($p=0.038$), and for tape + mid-top compared to tape + mid-top + spat ($p=0.026$). Taken together, these results suggest that both taping regimens restricted ROM over the barefoot condition, and that spatting on top of standard ankle taping restricted ROM more than standard ankle taping alone.

Comfort and Stability Perception

There was a significant difference in subjects' perception of comfort such that they perceived the low-top as being more comfortable than the mid-top ($p=0.015$; Fig. 4). However, there was not a significant difference in perception of stability between the two football shoes despite the fact that average stability scores were lower for the low-top versus the mid-top. There were no significant differences between the two drills in terms of subjects' perceptions of comfort and stability.

Performance Parameters

No significant differences were found between the low-top and mid-top shoes for any of the performance parameters measured (heart rate and time-to-completion in both drills, and measures of accuracy in the cutting drill) in either of the two drills.

Discussion

Our main findings were that the height of the football cleat did not change the effects of spatting on ankle ROM, despite the fact that the mid-top cleat covers the ankle malleolus, whereas the low-top cleat does not, and that subjects perceived the spatted low-top cleat as more comfortable

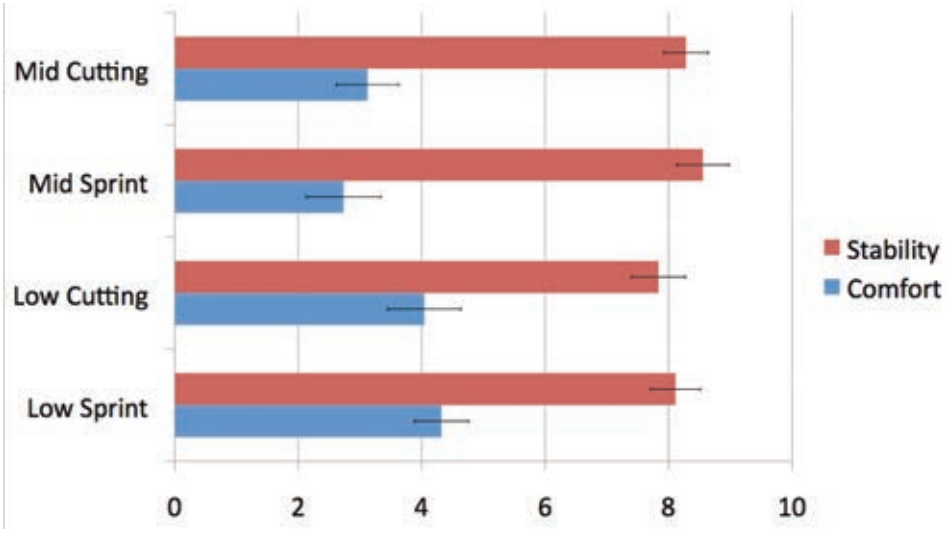

Figure 4: Athletes' perceived ankle comfort (blue) and ankle stability (red) assessed using a 10-cm visual analogue scale.

than the spatted mid-top cleat. Our data also hinted that subjects might have perceived the spatted mid-top cleat as more stable than the spatted low-top cleat, but our sample size was too small to achieve statistical significance.

These results are consistent with others in several ways, but also expand on current knowledge. Previous research has shown that ankle ROM decreased with increasing layers of tape or clothing on the ankle.[10,12,16,18] Our results (Fig. 3) echoed that, but also showed that football cleat height (at least among cleats like those commonly worn by running backs and receivers) does not influence ROM when ankles are taped and spatted. It is possible that differences would be found if a low-top cleat was compared to a high-top cleat because the difference in the height of the uppers would be greater, though brand new true high-top football cleats were not available at the time of the study. [Note: "¾ cleats" are the same as "mid-top cleats" in football footwear.] Some football players opt to wear soccer cleats because they are designed better for running on turf. Soccer cleats often have a lower cut than low-top football cleats, but it may be difficult to make comparisons between soccer cleats and football cleats due to differences in the uppers (materials, stitching patterns) or in studs and stud configurations. Future studies on football shoe height effects could explore soccer cleats or high-top cleats in comparison to the more widely used low- or mid-top football cleats as used in this study.

Regarding perception, we could not locate any studies that specifically investigated whether athletes found athletic shoes of varying heights to be more or less comfortable. The lack of research in this area has recently been discussed elsewhere.[7] One study investigating three different types of ankle braces reported that braces that elicited the higher ratings of perceived stability also elicited the lower ratings of perceived comfort, indicating that the two perceptions may be inversely related.[17] Both our team and another have shown that comfort expectedly decreases as layers of ankle restriction increase.[12,18] Athletes in our study rated the low-top cleat more comfortable than the high-top cleat when their ankles were taped and spatted, a finding congruent with the above studies, yet still novel. Though stability ratings were not significant in our study (likely due to small sampling size), they were lower for the mid-top cleat versus the high-top cleat, which would be consistent with the inverse relationship between comfort and stability noted earlier. Another interesting future experiment would be to have athletes wear shoes of differing heights during simulated games and then rate those shoes for comfort and stability as it appears there is no data on how the height of an athletic shoe influences its comfort or stability ratings. Such a study would be most feasible with basketball shoes or football cleats as manufacturers oftentimes produce a series of shoes with more or less identical soles but different uppers. Further research could also be done across different stud types such as blade, edge, flat, molded, pivot disk, or screw-in.

Performance outcomes did not differ based on ankle condition in our study, suggesting that there are no spatting-shoe height interactions among the cleats we tested. Previous work has indicated that spatting may or may not have performance effects.[2,12,16]

These findings may be helpful for athletes as well as coaches, athletic trainers, or other game personnel including sports medicine professionals. For athletes, the results suggest that low-top and mid-top cleats normally worn by running backs and receivers may provide similar benefits during practice drills and presumably during game scenarios, though we did not directly test the latter. In either practice or game scenarios, spatting may provide more of a placebo effect than actual benefit and the height of the cleat upper does not change the effects of spatting. For coaches and athletic trainers, these results suggest the additional height of mid-top cleats does not appear to have any additional benefits over low-top cleats, at least for players of builds similar to running backs and receivers, and at least for contexts such as those used in this study. Cleats selection, at least in terms of height, should be based on player preference. More importantly, the extra time, effort, and money required to spat ankles may not be justified from an injury prevention standpoint. All that said, the spatting of ankles may be an integral part of pre-game rituals for some teams, analogous to donning armor before battle, and as such may serve important social or psychological roles unrelated to athlete safety.

This work has some limitations. First, we tested only two ankle conditions in two football field drills. It is likely other results may have been obtained if other ankle conditions were used in other drills. The fact that our exercise bout lasted less than 10-min. does have an experimental design advantage though. Tape jobs are known to loosen as early as 15-min. post-application, and our study design eliminated that possible factor.[6,8,11] Second, we tested cleats most often used by running backs, receivers, and defensive backs, and our subjects were anthropometrically analogous to that population. It is likely that using different cleat models or athletes of different builds would produce different results. This means our results may not be applicable to all football players, as our athletes were on the smaller end of the football spectrum. Third, our sample size could have been increased to generate more statistical power, though given our specific results, the addition of more athletes may not have enhanced the findings too much. Fourth, our results were all based on acute effects and do not directly speak to injury prevention. Just because an ankle is more restricted does not mean it is more protected from ankle sprains.[19] One

study showed that National Football League athletes had similar ankle injury rates when spatted versus not spatted; although their sample size was low (12 or fewer athletes per group), that particular study may suggest the relation between spatting and injury prevention is poor.[14]

In conclusion, we demonstrated that there were perceptual differences, but not performance or ROM differences, when athletes' ankles were taped and spatted in football cleats of varying heights similar to what running backs or receivers use. Directions for future research are many and include investigating cleats that have greater differences in the heights of their uppers, recruiting athletes resembling a more diverse range of football player body shapes, investigating spatting performance in different types of drills, determining whether these effects are consistent on natural grass versus turf (as employed in this study), and determining whether similar results are found on actual game scenarios versus practice drills (as employed in this study). It is clear from the present data and literature review that much basic research still needs to be conducted on football cleats.

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