Effects of ball mark repair tools on an annual bluegrass green

When used correctly, all the golf course tools tested adequately repaired ball marks, but only a few could produce acceptable injury levels when they were used incorrectly.

Ball mark repair is essential to maintaining a smooth, level putting surface. Without it, cavities would remain on the putting surface, greatly disrupting future ball roll (3,9). Researchers have also found that repairing ball marks with any one of a variety of ball mark tools produces greater ball roll distances than not repairing ball marks (8).

Golfers have historically used a two-pronged repair tool, but many golfers are not properly trained to use these tools (3,8), and misusing them can be quite damaging. For example, correct use of a traditional two-pronged ball mark repair tool with 1.75-inch (4.5-centimeter) prongs resulted in smaller ball mark scars and better visual surface quality than improper use of the same tool (3). Ball marks that are repaired properly, following GCSAA recommendations, recovered almost twice as fast as improperly repaired ball marks (4). Currently, golfers use a number of straight and angle-shaped traditional two-pronged tools, with a variety of prong lengths, but no research has evaluated how these characteristics affect intended or incorrect usage of the tools.

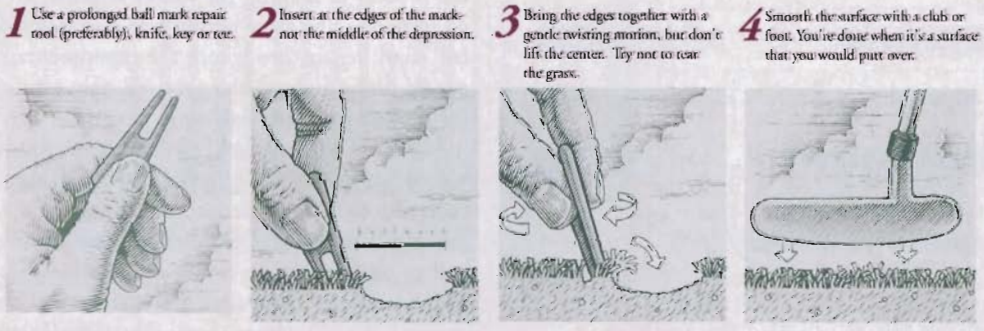
Restricted-entry repair tools

To prevent misuse of traditional two-pronged tools, manufacturers have developed restricted-entry, short-pronged ball mark repair tools because they believe that short prongs will not disrupt rooting or heave the putting surface if used improperly (1). However, when both traditional and restricted-entry ball mark repair tools are used properly, few or no differences in surface damage are observed (3). Sources suggest that when the restricted-entry repair tools are used improperly, they will produce less damage than the traditional repair tools, but this hypothesis has not been researched sufficiently (1,5).

A number of golf courses have banned the use of traditional ball mark repair tools, replacing them with restricted-entry repair tools. This policy change is reminiscent of the restriction imposed on metal golf shoe spikes that resulted in a consumer shift to alternative spikes (2,7).

Single-pronged tools

Finally, a golf tee or a single-pronged tool also



GCSAA's instructions on proper ball mark repair.

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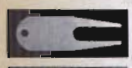
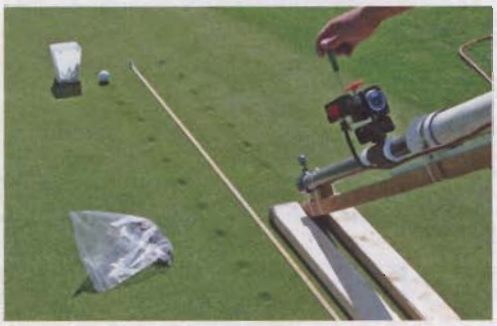
Ball mark repair tools

Repair tool		Prong length (Inches)	Prong length (Centimeters)
Double-pronged, restricted entry, straight			
	1	0.5	1.3
	2	0.5	1.3
Double-pronged, nonrestricted entry, straight			
	3	1.0	2.5
	4	1.2	3.0
	5	1.2	3.0
	6	1.4	3.5
	7	1.4	3.5
	8	1.4	3.5
	9	1.4	3.5
	10	>1.4	>3.5
Double-pronged, nonrestricted entry, angled			
	11	1.0	2.5
	12	1.0	2.5
	13	1.0	2.5
	14	1.4	3.5
	15	1.4	3.5
	16	>1.4	>3.5
Single-pronged, restricted entry, straight			
	17	1.2	3.0
Single-pronged, nonrestricted entry, straight			
	18*	>1.4	>3.5

*Standard golf tee.

Table 1. Ball mark repair tools used correctly or incorrectly on a practice putting green, Forest Akers GC, Michigan State University, East Lansing, 2007.



Pneumatic golf ball-ejection gun operated at a static pressure of 10 pounds/square inch (68.9 kilopascals) at the test site. **Photos by A. Kowalewski**

may reduce damage from improper ball mark repair because a single prong decreases the amount of surface area and underlying soil affected when the tool is inserted into the putting surface. Manufacturers have also begun developing restricted-insertion-depth single-pronged tools. However, these tools have not been adequately researched.

In this study, we evaluated the effectiveness of a variety of ball mark repair tools with a number of different physical characteristics when they were used both correctly and incorrectly on an annual bluegrass (*Poa annua*) putting green.

Materials and methods

In 2007, ball marks were created on July 16 (ball mark study 1) and Aug. 14 (ball mark study 2) on an annual bluegrass putting green at Forest Akers Golf Course on the campus of Michigan State University, East Lansing. The green we used for the research is typical of greens in the northern U.S.

Ball marks were made using a pneumatic ball-ejection gun developed at Rutgers University (New Brunswick, N.J.) operated at a static pressure of 10 psi (68.9 kilopascals) (6).

Each of 18 tools was used to repair ball marks correctly and incorrectly (Table 1). Repairs were replicated three times on both dates. Ball marks were repaired after all the ball marks were made; the process of making the marks required about 45 minutes. The same person was responsible for ball mark repair throughout the experimentation period on both dates and received only minimal instruction in proper ball mark repair. Before the initiation of this research, the ball mark repairer was taught to repair ball marks by inserting the tools into the putting surface at a 45-degree angle, four times around the perimeter of the ball mark and pushing down to return the displaced soil. For the incorrectly repaired ball marks, tools were inserted at a 90-degree angle, four times around the ball mark perimeter and pushed down, heav-

ing the turfgrass surface. Following both correct and incorrect ball mark repair, the putting surface was flattened using a putter.

Data collection included visual turfgrass injury ratings (1-9 scale, where 1 is no injury, 4 or higher is unacceptable and 9 is complete desiccation). Data for initial surface injury rates were collected seven days after ball marks were made, and data for recovery rates were collected 21 days after ball marks were made.

Results

Ball mark study 1 (July 16, 2007)

After the first set of ball marks were created, we observed few differences in injury when ball mark repair tools were used correctly (Figures 1, 2). When used correctly, all tools produced injury ratings below 4 (acceptable) throughout the data collection period.

In contrast, when the tools were used incorrectly, substantial differences were observed seven days after the ball marks were created (Figure 1). The restricted-insertion-depth ball mark repair tools (1, 2 and 17) were the only tools that produced injury ratings of less than 4 even when they were used incorrectly. Twenty-one days after the ball marks were applied, no statistical differences were observed between ball mark repair tools and their usage (Figure 2), and only tools 5, 7 and 16 caused injury ratings greater than 4 when they were used incorrectly. All these tools were double-pronged, nonrestricted-insertion-depth tools with prongs 1.2 inches (3.0 centimeters) or longer.

Ball mark study 2 (Aug. 14, 2007)

Data collected after the second set of ball marks was created support earlier results: there were few differences in injury among tool types when tools were used correctly (Figures 3, 4). Only one repair tool (18, the standard golf tee) produced an injury rating greater than 4 when it was used correctly; that injury was observed seven days after ball marks were made (Figure 3).

However, when these tools were used incorrectly, substantial differences were observed seven and 21 days after ball marks were created (Figures 3, 4). Again, the restricted-insertion-depth ball mark repair tools (1, 2 and 17) were the only tools that produced injury ratings below 4 when they were used incorrectly; this was observed seven days after ball marks were created (Figure 3). There were still significant differences between the correct and incorrect usage of a number of repair tools 21 days after ball marks were created (Figure 4).

Conclusions

When ball mark repair tools are used correctly, few differences are observed regardless of tool characteristics, and all tools typically produce an acceptable injury rating (less than 4). However, when these tools are used incorrectly, large differences are observed. In fact, seven days after both sets of ball marks were made, all tools (regardless of prong length or angle) except the restricted-insertion-depth tools (1, 2 and 17) produced injury ratings greater than 4.

Our results suggest that if golfers are properly trained to use ball mark repair tools, it makes no difference which tool is used. Conversely, when golfers are not properly trained, using restricted-insertion-depth single- or double-pronged tools will substantially reduce the potential for surface injury.

Correct ball mark repair (**A**), where tool was inserted into the putting surface at a 45-degree angle; incorrect repair (**B**), tool inserted into the putting surface at a 90-degree angle; and the result of improper ball mark repair (**C**).

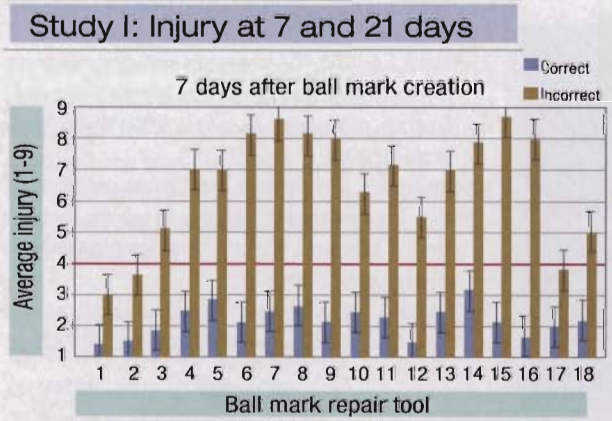


Figure 1. Ball mark repair tool (1-18) and usage (correct and incorrect) interaction on turfgrass injury (scale of 1-9, where 4 or more is unacceptable) observed in ball mark study 1, July 16, 2007. Data were collected seven days after ball marks were created on an annual bluegrass green. Error bars represent a least significant difference of 1.3.

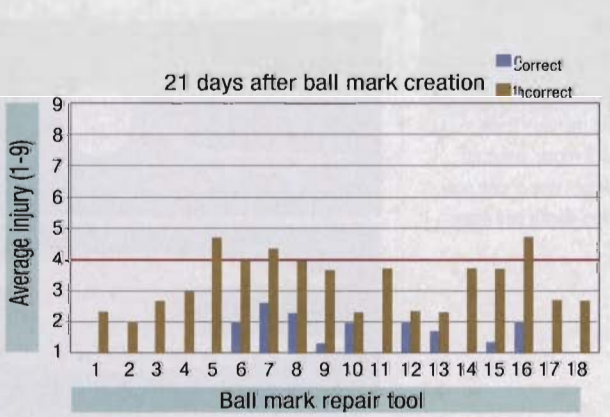


Figure 2. Ball mark repair tool (1-18) and usage (correct and incorrect) interaction on turfgrass injury (scale of 1-9, where 4 or more is unacceptable) observed in ball mark study 1, July 16, 2007. Data were collected 21 days after ball marks were created on an annual bluegrass green. No significant differences were observed.

Study II: Injury at 7 and 21 days

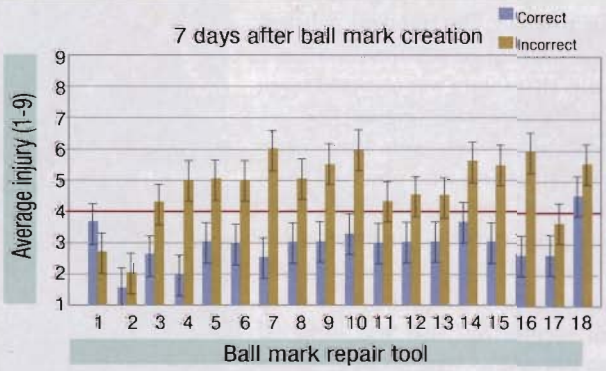


Figure 3. Ball mark repair tool (1-18) and usage (correct and incorrect) interaction on turfgrass injury (scale of 1-9, where 4 or more is unacceptable) observed in ball mark study 2, Aug. 14, 2007. Data were collected seven days after ball marks were created on an annual bluegrass green. Error bars represent a least significant difference of 1.5.

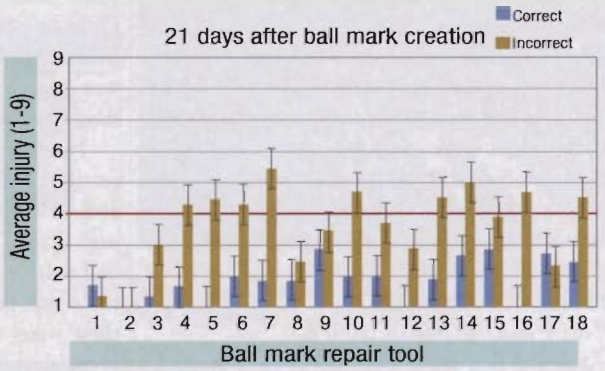


Figure 4. Ball mark repair tool (1-18) and usage (correct and incorrect) interaction on turfgrass injury (scale of 1-9, where 4 or more is unacceptable) observed in ball mark study 2, Aug. 14, 2007. Data were collected 21 days after ball marks were created on an annual bluegrass green. Error bars represent a least significant difference of 1.3.

The research says

→ When ball mark repair tools are used correctly, all types of tools typically produce an acceptable injury rating.

→ When ball mark repair tools are not used correctly, only restricted-insertion-depth tools produce acceptable levels of injury.

→ To reduce damage from improper ball mark repair, educate golfers on proper tool use or use only restricted-insertion-depth ball mark repair tools.

Superintendents concerned with putting surface damage caused by improper ball mark repair should educate golfers on proper tool use or recommend the use of restricted-insertion-depth ball mark repair tools. In response to these findings manufacturers have begun developing tools with both restricted and nonrestricted capabilities for the novice and seasoned golfer, respectively.

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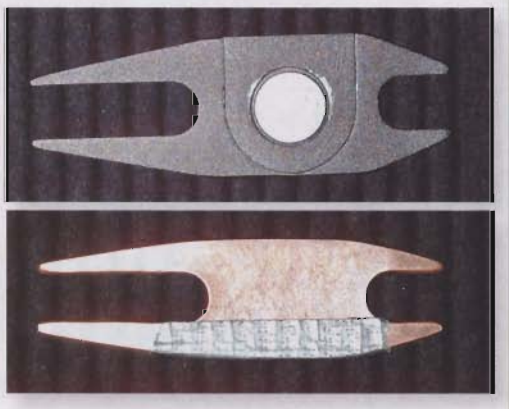

Recently developed ball mark repair tools have restricted-insertion-depth prongs on one end of the tool for the novice golfer (**right**) and nonrestricted-insertion-depth prongs on the opposite end of the tool for the seasoned golfer (**left**).

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