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Case Report

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Pain Management with Extracorporeal Shockwave Treatment in Multiple Level Clay-shoveler's Fracture in a Novice Golfer: A Case Report

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A 30-year-old male novice golfer was diagnosed with a clay-shoveler's fracture. During golf practice, he experienced persistent posterior neck and upper back pain for a month. Cervical radiographs and computed tomography revealed a series of sequential spinous process fractures from C7 to T3. The patient was prescribed analgesic medication and fitted with a cervical brace alongside extracorporeal shockwave therapy (ESWT) directed explicitly toward the upper back region, subsequently leading to a notable reduction in pain. Therefore, ESWT could be considered an additional method for pain management in patients with clay-shoveler's fractures.

Keywords: Clay-shoveler's fracture, Golf, Extracorporeal shockwave therapy, Spinous process

INTRODUCTION

Clay-shoveler's fractures, avulsion fractures of the spinous process, can result from direct trauma to the posterior neck or during strenuous activities involving torsional movement of the upper thoracic spine.[1] In the past, it often occurred during shoveling, but recently, these fractures have increasingly been reported during sports activities such as golf[2,3] and volleyball.[4] Single-level fractures are most common, primarily affecting the T1 level, followed by C7, T2, and T3, with multiple-level fractures being rare.[5] The most common symptom of a clay shoveler's fracture is localized pain in the upper back or neck, near the site of the fracture.[1]

Among various musculoskeletal pain management methods, extracorporeal shock wave therapy (ESWT) is widely used, especially in case of fractures.[6] ESWT may increase perfusion, promote angiogenesis to increase blood flow, and alter the pain signaling pathways of ischemic muscle tissue caused by calcium influx.[7] Also, ESWT is known to stimulate and reactivate the bone's healing ability in non-healing fractures.[6]

We recently experienced a 30-year-old male novice golfer with four consecutive levels of spinous process fractures. He suffered severe pain around the upper back area. We prescribed ESWT to manage pain and accelerate bone healing, and it showed significant pain relief following ESWT. Therefore, we aimed to present this case as evidence of the effectiveness of ESWT as a subacute pain management tool for multilevel clay-shoveler's fractures.

CASE REPORT

A 30-year-old male novice golfer visited the outpatient clinic due to persistent neck and upper back pain that began one month ago. He had six months of golfing experience and had recently completed two months of intensive golf practice. He initially felt discomfort in the cervical area but continued training while taking regular pain medicines. He also received several trigger point injections targeting the rhomboid and trapezius muscles. The pain had temporarily improved after conservative management, but later it worsened. He also had no family history of a particular disease. He didn't smoke and only drank alcohol socially. Recently, the patient has

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been healthy and active. He had no previous specific medical history or was taking any other medications except painkillers.

At the initial visit to our clinic, he complained of tenderness around the C7 spinous process with severe pain. Some slight restriction in the cervical range of motion was observed due to pain, with particularly severe complaints of pain during flexion. However, it was not a pain radiating into the upper extremities during neck flexion. Mild swelling was around the painful area, but no bruise or infection signs were observed. The characteristic of pain was sharp and squeezing. He described the pain gradually worsening over time, becoming more pronounced during his golf swing. His pain was assessed using the numeric rating scale (NRS), and he reported ten while playing golf and six while resting.

He was 182cm tall and weighed 77kg. Any weakness, increased muscle tone, or decreased sensation was not observed in both upper and lower extremities. And deep tendon reflexes were also normal, and no pathologic reflex was observed. Due to the severe pain, there was a moderately restricted active and passive range of motion in neck flexion, extension, rotation, and lateral flexion.

His cervical radiography revealed fractures of C7 and T1 spinous processes (Figure 1). Therefore, the cervical computed tomography (CT) scan was immediately performed, and it also identified multiple fractures of C7-T3 spinous processes (Figure 2). However, no other specific abnormalities were observed in his cervical CT scan. The bone mineral density test of the lumbar spine and hip areas was also checked, but it showed average values of bone density. Finally, clay-shoveler's fractures at the C7-T3 spine were diagnosed, and the cause of his neck pain was presumed to be multiple cervical spinous process fractures.

Despite the diagnosis of multiple fractures in cervical spinous processes, it seemed that these fractures didn't significantly affect the stability of the cervical spine. Therefore, we prescribed a Philadelphia brace to limit neck motion and provided analgesic medications, including a nonsteroidal anti-inflammatory drug (NSAID), an opioid, and a muscle relaxant. And we instructed the patient to stop playing golf and other active physical activities. One week later, the patient complained of severe neck and upper back pain and difficulty in daily living. Then, we decided to undergo ESWT to manage his neck and upper back pain. An experienced physiotherapist conducted ESWT twice a week for four weeks. The extracorporeal shock waves were delivered with the energy flux density of 2.5mJ/mm^2, 2,000 impulses, and a frequency of 9.0Hz using SALUS-RSWT (REMED, Daejeon, Korea). ESWT was administered to the region surrounding rhomboid muscles between both scapulas, explicitly targeting the most painful areas. Because the prescribed NSAID was known to po-

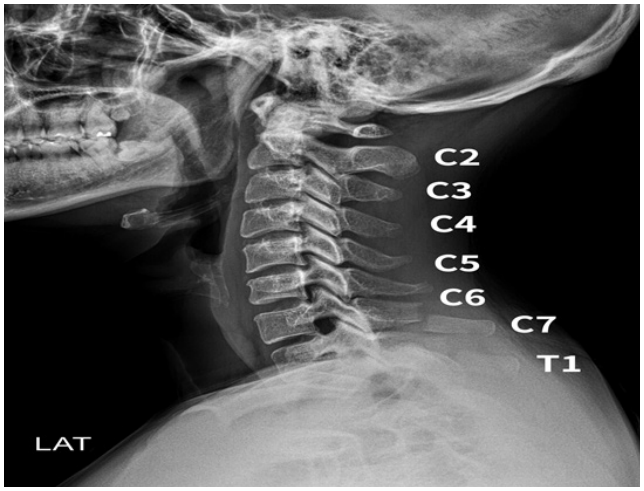

Figure 1. Cervical spine radiograph (lateral view)

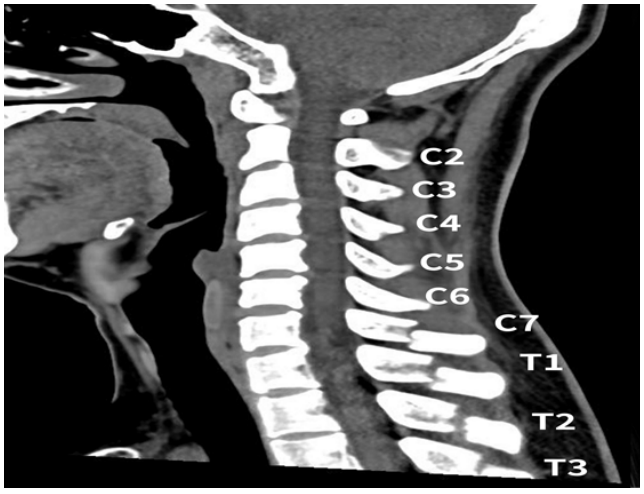

Figure 2. Cervical spine computed tomography (lateral view)

Figure 3. Cervical spine radiograph (lateral view) at 10-week follow-up

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tentially interfere with ESWT's effectiveness, it was discontinued during the ESWT treatment period. Other than ESWT, additional physiotherapy, manipulation, or exercise were not employed.

Immediately after the first session, the patient felt significant pain relief, showing reduced NRS from 6 to 3. After two weeks of ESWT, pain was dramatically improved except when extending the neck. Finally, by the end of the fourth week, he was utterly free from any discomfort. Also, no adverse event or severe ESWT-related pain was observed. After eight sessions of ESWT treatment, no additional ESWT session was planned, and only regular monitoring involves cervical lateral radiograph follow-ups conducted every two weeks. At the 10-week follow-up, there was some evidence of bone healing, but the complete union of the fractured bone had not been attained (Figure 3). Afterward, the patient could return to daily life without discomfort. However, active exercise remained restricted.

DISCUSSION

Clay-shoveler's fractures are a type of fracture that typically occurs in spinous processes of the lower cervical or upper thoracic spine.[1] Clay-shoveler's fractures are usually the result of sudden, forceful pulling or contraction of the muscles and ligaments attached to these spinous processes. As the name suggests, clay-shoveler's fractures were frequently observed in manual laborers who dug or shoveled.[1] Recently, fractures have also been observed among athletes who engage in rotational movements of the upper trunk.[2,4] These fractures are typically seen at a single spinal level, and occurrences in multiple levels, as seen in this case, are rare.[5]

The muscles that attach to the spinous processes of the lower cervical and upper thoracic spine include erector spinae, rhomboid, and trapezius muscles. Among these, a previous study suggested a link between the trapezius muscle and clay-shoveler's fractures in golf players.[2] During both the back swing and forward swing in golf, the trapezius muscle contracts and plays a role in the movement of the scapula rotation.[8] In the case of beginners who may improperly strike the ground or make faulty swings, there is a possibility that the accumulated force in the trapezius muscle during the backswing may not be effectively transmitted to the golf ball during the forward swing.[2] In such instances, any remaining force or counterforce may act on the spinous processes, potentially leading to a spinous process fracture if enough force is transmitted through the trapezius tendon.

While professionals or experienced amateurs can generate power through smooth and coordinated body rotation, it might be challenging for this patient as a beginner. The forceful and sudden rotation caused by strong neck, torso, and shoulder muscle contractions would have exerted higher pressure, particularly on the lower cervical and thoracic spine connected to the upper extremities.[2,8] Also, he was young so he could exert an even greater force on the spine than an older person. Furthermore, increased physical activity levels may have elevated the risk of fractures due to repetitive stress.[1]

Aside from clay-shoveler's fractures, various other types of fractures in different body regions, including rib fractures, have been reported among golf players.[9] Due to the use of heavy clubs, the risk of injury appears to be higher than in other sports. Therefore, it is advisable for beginners to initially use lighter clubs and soft shafts and undergo sufficient lessons to learn proper swing posture and techniques. Also, an appropriate amount of exercise and rest should be necessary to prevent musculoskeletal injuries.

Fortunately, clay-shoveler's fractures can typically be improved with conservative treatments.[1,10] Treatment usually involves rest, pain medication, and occasionally using a brace or collar to stabilize the affected area. Surgical intervention may be necessary if complications or instability are associated with the fracture.[11] Although the clinical prognosis is relatively good in clay-shoveler fractures, patients might suffer pain during recovery.[1] Thus, it is essential to consider pain management as part of the treatment plan.

Among the various approaches to managing musculoskeletal pain management, ESWT presents a promising adjunctive option for pain management in individuals with clay-shoveler's fractures. The precise mechanisms of ESWT's effects on musculoskeletal diseases remain incompletely understood.[12] However, several hypotheses have been put forward, including the induction of microtrauma and cellular responses, promotion of neovascularization, initiation of the release of various growth factors, and recruitment of mesenchymal stem cells.[7] Prior research has already convincingly demonstrated the favorable effects of ESWT in addressing a variety of soft tissue injuries, yielding promising outcomes in pain management and functional recovery.[12,13] Notably, its effectiveness has been well-documented, especially in chronic tendiopathies[12,13], and it has also shown positive results in the context of fractures.[13]

Even though this case was not a chronic condition, it resulted in a remarkable 50% improvement in the pain score after the first session of ESWT. This suggests that ESWT may not only facilitate tissue regeneration but also have a positive impact on pain relief, providing valuable insights into its therapeutic effectiveness. A previous systematic review has also reported the efficacy of ESWT, even in patients with subacute muscu-

loskeletal conditions.[12] A critical mechanism of acute effect is the modulation of nitric oxide (NO) release.[12] NO offers pain relief in several ways. NO is the mediator of the analgesic effect of opioids, so NO could directly reduce pain.[14] Also, NO indirectly reduces pain by increasing circulation to restore average membrane potential and reduce pressure on nerves due to localized edema.[14] A single ESWT session applied to full-thickness soft tissue wounds in mouse skin has been shown to elevate NO levels, endothelial nitric oxide synthase, and proangiogenic chemokines and cytokines. Similarly, ESWT leads to a persistent improvement in blood perfusion in the ischemic muscle of rats.[15] Based on these mechanisms, the patient's pain may have been effectively alleviated from the early session of ESWT treatment, and further improvement was observed through repeated sessions in this case.

Furthermore, many studies did not report severe adverse effects associated with ESWT and reported mild side effects and resolved spontaneously.[12] Therefore, ESWT has become a popular non-invasive pain management tool for musculoskeletal diseases because of its safety and effectiveness. Especially in cases involving fractures, it is often challenging to perform manipulation or exercises. Also, usually, more than pain control through medication alone is required. Therefore, in situations where these treatment options are limited, ESWT is considered a valuable choice for conservative management.

REFERENCES

1. Posthuma de Boer J, van Wulfften Palthe AF, Stadhouder A et al. The clay shoveler's fracture: a case report and review of the literature. J Emerg Med. 2016;51:292-7.
2. Kim SY, Chung SK, Kim DY. Multiple cervical spinous process fractures in a novice golf player. J Korean Neurosurg Soc. 2012;52:570-3.
3. Kang DH, Lee SH. Multiple spinous process fractures of the thoracic vertebrae (Clay-Shoveler's Fracture) in a beginning golfer: a case report. Spine (Phila Pa 1976). 2009;34:E534-7.
4. Hetsroni I, Mann G, Dolev E et al. Clay shoveler's fracture in a volleyball player. Phys Sportsmed. 2005;33:38-42.
5. Akhaddar A, Mandour C. Multiple contiguous cervicothoracic Clay-shoveler's fractures (from C6 to T9 spinal vertebrae). Pan Afr Med J. 2013;16:128.
6 Petrisor BA, Lisson S, Sprague S. Extracorporeal shockwave therapy: a systemic review of its use in fracture management. Indian J Orthop. 2009;43:161-7.
7. Simplicio CL, Purita J, Murrell W et al. Extracorporeal shock wave therapy mechanisms in musculoskeletal regenerative medicine. J Clin Orthop Trauma. 2020;11:S309-18.
8. McHardy A, Pollard H. Muscle activity during the golf swing. Br J Sports Med. 2005;39:799-804.
9. Lee AD. Golf-related stress fractures: a structured review of the literature. J Can Chiropr Assoc. 2009;53:290-9.
10. Lee H, Yoon E, Choi G et al. Multiple episodes of golf-related isolated spinous process fractures (clay-shoveler's fracture) and its ten-year follow-up. Trauma Case Rep. 2023;47:100903.
11. Murphy RF, Hedequist D. Excision of symptomatic spinous process nonunion in adolescent athletes. Am J Orthop (Belle Mead NJ). 2015;44:515-7.
12. Pittner A, Stoiber W, Pittner S et al. Extracoporeal shock wave therapy in acute injury care: a systemic review. 2018;7:1-13.
13. Schmitz C, DePace R. Pain relief by extracorporeal shockwave therapy: an update on the current understanding. Urol Res. 2009;37:231-4.
14. Cury Y, Picolo G, Gutierrez VP et al. Pain and analgesia: the dual effect of nitric oxide in the nociceptive system. Nitric Oxide. 2011;25:243-54.
15. Tepekoylu C, Lobenwein D, Urbschat A et al. Shock wave treatment after hindlimb ischaemia results in increased perfusion and M2 macrophage presence. J Tissue Eng Regen Med. 2018;12:e486-94.

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