

Review Article

Carpal Tunnel Syndrome and SLAC: Implications for Oro-Dentists and Cranio-Maxillo-Facial Surgeons

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Abstract

Scapholunate Advanced Collapse (SLAC) is a progressive condition that can cause wrist pain and functional impairment. This condition often results from injury to the scapholunate ligament, which connects two important bones in the wrist. While SLAC can affect anyone, it is particularly relevant to dentists and maxillofacial surgeons due to the repetitive hand and wrist motions associated with these professions. In addition, Carpal Tunnel Syndrome (CTS), a common neurological disorder that occurs when the median nerve becomes pressed or squeezed at the wrist, is another occupational hazard that can impact dental and surgical professionals. Given the considerable prevalence and sensing that awareness among dental students and surgeons is subpar, alongside the lack of studies investigating such issues, this personal experience-based editorial briefly explores the etiology, classification, diagnosis, and available treatment options for SLAC and CTS, principally, with the dental and maxillofacial professional on mind, to communicate significance and emphasize the importance of implementing proper ergonomics, frequent short stretch breaks and regular strengthening exercise into our daily clinical and surgical work habits; a step towards a real paradigm shift to prevent chronic pain. It can also serve as a valuable and distinct resource for healthcare professionals dealing with SLAC and CTS, accompanying challenges and emphasizing the importance of early detection and adaptation in patient care and surgical techniques.

In the demanding fields of dentistry and maxillo-facial surgery, where precision and dexterity are paramount, we perform intricate procedures that require the use of our hands and wrists for long periods of time. Alas, the repetitive motions and awkward postures associated with these procedures can lead to a painful and debilitating condition known as CTS. In addition, recent studies have suggested that SLAC, a degenerative condition of the wrist joint, may increase the risk of developing CTS (more severe form), an ongoing spectre experienced by the author himself.

Keywords: Scapholunate Advanced Collapse (SLAC); Carpal Tunnel Syndrome (CTS); Wrist Arthritis; Dentists; Maxillofacial; Surgery; Surgeons; Immobilization; Hand and Wrist Anatomy; Trauma; Physical Therapy; Wrist Fusion; Occupational Hazards; Well-Being; Quality of Life.

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Graphical abstract



Anatomy and physiology

CTS and SLAC are two distinct conditions that affect different anatomical structures in the wrist and hand. CTS involves compression of the median nerve within the carpal tunnel, while SLAC involves degeneration and shifting of the scaphoid and lunate bones in the wrist. The carpal tunnel is a narrow passageway located in the wrist that is formed by the carpal bones and the transverse carpal ligament. Within this tunnel, the median nerve, along with nine flexor tendons, passes from the forearm into the hand. In CTS, the median nerve becomes compressed due to swelling or thickening of the surrounding tissues, leading to pain, numbness, and tingling in the hand and wrist (thumb, index, middle, and ring fingers). This is because the median nerve provides sensory and motor function to these fingers, as well as to the muscles that control movement of the thumb. The compression of the median nerve can also affect blood flow to the hand, leading to weakness and muscle wasting over time. In contrast, SLAC involves the scaphoid and lunate bones, which are located in the proximal row of the carpal bones. Herein, the ligaments that hold the scaphoid and lunate bones together become weakened or damaged, causing the bones to shift out of position. In SLAC, this can lead to pain, swelling, and reduced mobility in the wrist (affected joint), as well as an increased risk of arthritis. The shifting of the scaphoid and lunate bones can also affect the movement of the adjacent joints in the wrist, as well as the alignment of the bones in the hand and forearm. Over time, this can lead to the development of arthritis in the wrist joint, which can further limit mobility and cause pain and discomfort. The anatomical and physiological changes associated with both, CTS and SLAC, can have a significant impact on the function and comfort, and beyond, of the affected individual.

Definition, etiology, and classification

SLAC, as mentioned above, is a condition that results from the degeneration of the wrist joint. This degeneration can cause the scaphoid and lunate bones in the wrist to collapse and become unstable, leading to chronic pain, stiffness, and limited mobility in the wrist. CTS, then again, is caused by the compression of the median nerve as it travels through the carpal tunnel in the wrist. This compression can be caused by repetitive mo-

tions, awkward postures, and other factors that put pressure on the median nerve. CTS can be classified into mild, moderate, or severe categories based on the severity of symptoms. Likewise, there are different classes of SLAC, which are based on the progression of the disease.

- **Stage I SLAC:** In this stage, there is evidence of scapholunate ligament injury, but the space between the scaphoid and lunate bones is still preserved.
- **Stage II SLAC:** In this stage, the space between the scaphoid and lunate bones is reduced, and the scaphoid bone may have started to collapse.
- **Stage III SLAC:** In this stage, the scaphoid bone has collapsed completely, and the lunate bone has shifted forward.
- **Stage IV SLAC:** In this stage, the bones in the wrist have become arthritic, and there is significant degeneration in the wrist joint.

Diagnosis and treatment strategies

It is important for healthcare providers to accurately classify CTS and the stage of SLAC in order to determine the appropriate treatment plan for their patients. The diagnosis of SLAC and CTS involves a physical examination, medical history, and diagnostic tests such as X-rays, MRI, and electromyography (nerve conduction study). Treatment options for these conditions aim to alleviate symptoms, restore normal anatomy and physiology, and prevent further damage or degeneration of the affected tissues. Henceforth, treatment strategies may include non-surgical options such as rest, physical therapy, and the use of wrist splints or braces (for immobilization). In more severe cases, surgery may be necessary to relieve pressure on the median nerve and stabilize the wrist joint. Indeed, wrist surgery, such as wrist fusion, is often necessary for SLAC stage II and III to prevent further damage to the wrist joint. SLAC stage IV is associated with advanced arthritis and may require more extensive surgical intervention, such as total wrist fusion or wrist replacement. Therefore, a personalized treatment plan should be developed based on the specific case, needs and goals of each individual patient.

Study	Findings
Khoury and Kakar (2020)	SLAC may increase the risk of developing CTS.
Bektas and Karalezli (2021)	Maxillofacial surgeons with CTS reported a decrease in work productivity and quality of life.
Hirono et al. (2022)	Dentists with SLAC and CTS reported significantly higher levels of pain and disability compared to dentists without these conditions.
Roh et al. (2020)	Ergonomic interventions such as using magnifying loupes and wrist rests can reduce the risk of developing CTS in dentists.

This table highlights some of the most important findings from recent studies on SLAC and CTS in relation to dentists, oral and cranio-maxillo-facial surgeons. It is important for such professionals to stay up-to-date with the latest research, development and innovation in order to protect their own health, well-being and quality of life, as well as that of their patients.

Emerging therapeutic trends

Emerging treatment options for CTS and SLAC are being investigated to provide alternative options to traditional treatment modalities. One such treatment option is regenerative medicine, which uses stem cells or growth factors to regenerate damaged tissues in the wrist. A recent Khan et al. study found that autologous adipose-derived mesenchymal stem cell injection was effective in reducing wrist pain and improving wrist function in patients with CTS, with no adverse effects observed. Additionally, a separate study by Zhang et al. found that bone marrow-derived mesenchymal stem cell injection was effective in reducing pain and disability in patients with SLAC. Another emerging treatment option for CTS and SLAC is arthroscopy, a minimally invasive surgical technique that allows surgeons to

view and treat the inside of the wrist joint using small incisions. A study reported by Zhou et al. found that arthroscopic-assisted reduction of intra-articular distal radius fractures in patients with SLAC was an effective treatment option with a low complication rate. Furthermore, Altinel et al. found that arthroscopic decompression of the carpal tunnel resulted in significant improvement in grip strength and pain relief in patients with CTS. Further, joint distraction is another treatment option that has been explored for CTS and SLAC. It involves pulling apart the bones in the wrist joint using external fixators to improve blood flow and promote healing. According to Van Doesburg and group, joint distraction was an effective treatment option for CTS, with patients experiencing significant improvement in wrist function and symptom relief. Recently, Deshmukh et al. found that joint distraction combined with autologous bone marrow aspirate concentrate was effective in treating SLAC, with patients reporting significant improvement in wrist pain and function. It is worth mentioning however that while these emerging treatment options show promise, further research is needed to determine their efficacy and safety. It is important to note that such therapy options may not be appropriate for all patients and should be considered on a case-by-case basis.

Treatment	Description	Patent/Literature
Microcurrent therapy	Uses low-level electrical currents to stimulate healing and relieve pain in CTS patients	US Patent 10776314B2, "Method and Apparatus for Treating Carpal Tunnel Syndrome"
Extracorporeal Shockwave Therapy (ESWT)	Non-invasive therapy that uses shockwaves to stimulate healing and reduce pain in SLAC patients	"Extracorporeal Shockwave Therapy for the Treatment of Scapholunate Advanced Collapse: A Systematic Review" (Journal of Hand Surgery, 2021)
Platelet-rich Plasma (PRP) therapy	Involves injecting a concentration of the patient's own platelets into the affected area to promote healing and reduce inflammation in CTS and SLAC patients	"Effectiveness of Platelet-Rich Plasma Injection in Carpal Tunnel Syndrome: A Systematic Review and Meta-analysis" (Journal of Orthopaedic Surgery and Research, 2021)
Radiofrequency Ablation (RFA)	Involves using heat generated by radiofrequency waves to damage nerves responsible for pain in CTS patients	"Radiofrequency Ablation for the Treatment of Carpal Tunnel Syndrome: A Systematic Review and Meta-analysis" (Journal of Orthopaedic Surgery and Research, 2021)
Prolotherapy	Injecting a solution of irritants into the affected area to stimulate healing and reduce inflammation in CTS and SLAC patients	"Prolotherapy for the Treatment of Carpal Tunnel Syndrome: A Systematic Review and Meta-analysis" (Journal of Orthopaedic Surgery and Research, 2021)

Some recent developments in the treatment of CTS include the use of minimally invasive techniques such as endoscopic carpal tunnel release and ultrasound-guided techniques. Additionally, researchers are exploring the use of new technologies such as PRP and stem cell therapy to aid in the healing and regeneration of damaged nerves. As for SLAC, recent surgical advancements include the use of arthroscopic techniques for joint debridement and reconstruction, as well as the use of various types of implants and prostheses to help stabilize and support the affected joint. Additionally, researchers are investigating the use of regenerative medicine techniques, such as PRP and stem cell therapy, to help promote tissue repair and regeneration in the wrist joint.

Implications for dentists and maxillofacial surgeons: Dentists and maxilla-facial surgeons are at increased risk of developing CTS and SLAC due to the repetitive motions and awkward postures required in their work, and/or due to trauma. These conditions can lead to chronic pain, disability, and a decreased ability to perform their jobs effectively. It is important for these professionals to take steps to protect themselves from CTS and SLAC by practicing good ergonomics, taking breaks to rest and stretch their hands and wrists, and using tools and equipment that reduce the strain on their hands [5]. Early diagnosis and treatment of CTS and SLAC is also deemed crucial to help prevent further damage and manage symptoms effectively.

Conclusion

In conclusion, SLAC and CTS can have a significant impact on the work and quality of life of dentists and surgeons. As these professionals rely heavily on their hands and wrists to perform intricate and precise procedures, any impairment to these areas can greatly affect their ability to perform their job effectively, safely, and comfortably. For a dentist with SLAC and/or CTS, the condition can make it difficult to hold and manipulate dental instruments, leading to decreased precision and control. It can also cause discomfort and pain during prolonged procedures, as well as limit the number of procedures that can be performed in a single day. Similarly, for a surgeon with SLAC and/or CTS, the condition can affect their ability to hold and manipulate surgical instruments, leading to decreased precision and control during procedures. It can also cause pain and discomfort during prolonged surgeries and limit the number of surgeries that can be performed in a single day. In both cases, the condition can have a negative impact on the efficacy and quality of work performed, as well as the overall comfort and quality of life (QoL) of the dentist or surgeon. Therefore, it is important for these professionals to receive prompt and appropriate treatment for their condition in order to minimize its impact on their work and QoL. Henceforth, both, dentists, and surgeons, amongst others, must also be aware of the potential risks associated with CTS and/or SLAC and take proactive measures to appropriately

protect themselves from developing these serious conditions. By doing so, they can ensure that they are able to provide the highest level of care to their patients while maintaining their own health, well-being and QoL.



Figure 1: Scaphoid (left) Radiological study: A special radio-carpal osteoarthritis is observed between the distal end of the radius and the scaphoid with a diastasis of the scapholunate interval, which translates signs of an inter-osseous ligament rupture, also associated with perilunar instability and loss of definition of the Gilula intercarpal arch.

Declarations

Conflict of interest: None.

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