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A Comparison of Treatment Options for Carpal Boss: A Critically Appraised Topic

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Context: Carpal bossing is a bony growth or mass that typically occurs at the 2nd or 3rd carpometacarpal joint. Carpal bossing is often overlooked placing the patient at an increased risk for pain or injury, such as osteoarthritis or inflammatory joint disease if left untreated. Individuals such as combat sport athletes who experience repetitive trauma to this area are at a high risk to develop carpal bossing. The literature suggests conservative or surgical interventions to manage symptoms. The goal of this systematic review is to synthesize the current literature for clinical knowledge and intervention outcomes for carpal bossing. **Methods:** A systematic search of the literature was performed across three electronic databases (Science Direct, PubMed, and EDSCOhost) to identify articles that investigated the effects of surgical intervention or conservative management for carpal bossing. A combination of the keywords and Boolean Operators (Carpal Bossing, Carpal Boss, Surgical Intervention, Wedge Resection, Excision, Conservative Treatment, and Intervention) related to the research question were used. The search was restricted to full text, human studies (including cadaveric studies) research, and manuscripts available in English. Articles were included if they examined the effect of either conservative or surgical interventions for the treatment of carpal bossing. Articles were excluded from the review if the study did not examine carpal bossing treatment options or it did not include pain, range of motion, strength, or functional measures of the hand and wrist. Two independent reviewers used the Joanna Briggs Institute Checklist for Case Reports and Checklist for Case Studies to appraise the quality of the articles. A score of 50% was used to remove low-quality studies. The Strength of Recommendation Taxonomy (SORT) method was used to grade the evidence for the articles included. **Results:** After the initial search, 10 articles et the inclusion criteria, while 3 were eliminated due to low quality appraisal scores. The average scores for case reports and case studies were 5.5/7 or 7.5/9 respectively. There was s total of 58 participants across the 7 studies. Generally speaking, conservative treatment reduced average daily pain and patients were able to return to full participating within two weeks. Conversely, patients undergoing surgical intervention experience episodic pain, including over the surgical incision, typically averaging 2/10 on the Visual Analog Scale. Findings from the surgical intervention showed inconsistent measurements for wrist/hand strength and range of motion. There is level C evidence on the treatment for carpal bossing. **Conclusion:** The limited evidence suggests conservative management may reduce pain and improve clinical outcomes. However, clinicians should consider level C evidence with skepticism as the quality on this topic is low. Further investigations should be performed with more rigor. ***Key Words:*** *Carpal Bossing, Os Styloideum*

INTRODUCTION

Carpal bossing, or os styloideum, is a bony growth or mass that most commonly occurs at the 2nd or 3rd carpometacarpal joint, and can cause pain.[1] This condition is widely overlooked, due to more common pathologies affecting this area, such as carpal tunnel syndrome or De Quervain's tenosynovitis.[2] Many cases of carpal bossing are asymptomatic and are found coincidentally on radiographic imaging.[2] Carpal Bossing has an unclear etiology, but is believed to be caused by repetitive trauma or from an os styloideum that grows and causes a prominent bony mass to form on the dorsal side of the hand.[3] This alteration in the bony anatomy of the hand and wrist may affect the surrounding tissues.[4] This condition has the ability to lead to more

serious conditions, such as a tendon rupture, inflammatory joint disease, and/or degenerative joint disease.[5]

Combat sport athletes, such as boxers or mixed-martial arts fighters, have a higher risk of hand injuries that may affect their ability to participate.[4] Carpal bossing is destabilizing to the 2nd or 3rd carpometacarpal joint, and is reported as one of the most prevalent hand injuries affecting this population, second only to boxer's knuckle.[4] A clenched-fist position, coupled with repetitive forceful punching motions that are necessary for their sport, may put these athletes at a higher risk of injury or structural changes to their hands. Due to the demands of combat sports, maintaining hand integrity and strength is vital to success.[4]

Carpal bossing can be treated using either conservative or surgical interventions. Typically, conservative treatment will last around six weeks. The goal of this treatment is to limit painful motion at the wrist and decrease irritation in the painful area.[5] Conservative methods seek to eliminate pain caused by any changes in the anatomical structures.[3] These methods may include bracing, icing the painful area, using non-steroidal anti-inflammatory drugs (NSAIDs), and rehabilitation exercises.[3] Rehabilitation exercises for this condition seek to restore wrist and hand range of motion, especially following a prolonged period of immobilization. They are also chosen to improve wrist and hand strength overall.[4] Conservative treatment is pursued as a non-invasive method to help relieve pain. If unsuccessful, surgical options may be considered.

The surgical treatment for carpal bossing consists of either removing the bone growth through an excision, or stabilizing the joint through pins placed into the affected area.[4] The procedure aims to maintain optimal joint function, while lowering the risk of irreplaceable damage and increasing the integrity of this critical extensor unit.[4-5] However, repetitive trauma or stress has potential to cause pain if not repaired or addressed.[5] Surgery for this injury is typically an outpatient procedure and follows the guidelines for surgical and tissue healing times.[6] The cost of these procedures may vary based on insurance coverage and medical necessity definitions, but other comparable hand surgeries had as high as $2576 in out-of-pocket responsibility for the patient, even with insurance coverage.[7] Therefore, this treatment option may not be viable for every patient presenting with carpal bossing.

If left untreated, carpal bossing can cause pain and swelling on the dorsal side of the hand and wrist.[8] However, many of the studies that include this condition are case studies or case report.[9-15] To date, no systematic review has been conducted to compare the treatment options available for this condition. The goal of this systematic review is to consolidate, analyze, and synthesize the current literature for clinical knowledge and use regarding carpal bossing.

METHODS

Search Strategy

The following databases were searched for studies between the years of 1990 and March 2021. PubMed, Science Direct, and the EBSCOhost collection. A combination of terms related to carpal bossing, conservative treatment, and surgical intervention, along with the Boolean operators of *AND OR* (Table 1) were used. The search was restricted to human studies research and manuscripts available in English.

Step	Search Terms	Boolean Operator	EBSCO Host	PubMed	Sport Discus
1	Carpal bossing, Bossing, Os Styloideum	OR	300	690	14
2	Surgical Intervention, Simple Excision, Wedge Reduction	OR	26,182	1,882,207	16,86
3	Conservative Treatment, Rehabilitation	OR	432,478	640,773	94,274
4	1,2,3	AND	1,121	2,383	720
Duplicates					230
Total # Identified					5,444

Table. 1 Search Terms and Articles Identified in Initial Search

Selection Criteria

The articles identified from the systematic search were screened for the inclusion and exclusion criteria below. The titles and abstract were screened by the primary investigator, with the full-text manuscript being assessed if the eligibility could not be determined initially. Consensus with the second investigator was included in the screening process to resolve any uncertainties regarding the eligibility of the articles.

Inclusion Criteria

The following are the criteria used to determine if the articles met the eligibility for this review: 1) peer-reviewed, 2) English language publications, 3) performed on human subjects, and 4) investigated the following: carpal boss, carpal bossing, or os styloideum.

Exclusion Criteria

The following criteria were used to exclude articles from this review: 1) non-English publications, 2) studies were performed on animals, and 3) if there was no study done on carpal bossing.

The initial search yielded 5,675 articles in total across all three databases. Once duplicates were removed, the search resulted in a total of 5,444 articles. These articles were screened by title and abstract for relevance and inclusion criteria, with a final result of ten relevant studies. These ten studies then underwent a critical appraisal for methodologic quality. Out of ten articles, seven had a high enough methodologic score to be included in the final systematic review.

Methodologic Quality

The Joanna Briggs Institute "Critical Appraisal Tool Checklist for Case Reports" was used to appraise the quality of the case studies or reports that were included in the review and consisted of only one (1) participant. This appraisal tool is composed of 8 items, with each item being scored with "Yes", "No", "Unclear", and "Not Applicable". Two investigators scored each article that was eligible for inclusion independently. For each "Yes" score, 1 point was given, whereas each "No" or "Unclear" was given 0 points. When disagreements between scores arose, the reviewers met to discuss and come to a consensus. The summary score (8 points total) was used to eliminate low quality studies; a score of 4 (50%) or higher was needed for inclusion.

Similarly, the Joanna Briggs Institute "Critical Appraisal Tool Checklist Case Series" was used to appraise the quality of case studies included in the review that consisted of two or more participants. This appraisal tool is composed of ten items, with each item being scored with "Yes", "No", "Unclear", and "Not Applicable". Two independent investigators scored each article that was eligible for inclusion. For each "Yes" score, 1 point was given, whereas each "No" or "Unclear" was given 0 points. When disagreements between scores arose, the reviewers met to discuss and come to a consensus. The summary score (10 points total) was used to eliminate low quality

studies; a score of 5 (50%) or higher was needed for inclusion

Data Extraction and Synthesis

The data gathered from the articles was as follows: intervention performed, intervention parameters, subjects, and outcomes. The clinical outcome measures extracted from the articles were range of motion measurements and strength of the affected muscles, along with occurrence of reinjury following a treatment course; whereas the patient rated outcomes taken were pain level and patient-reported function following a treatment course. The results of the studies were extracted from each study and analyzed according to the outcomes and results.

RESULTS

Search Results

The searches of the electronic databases yielded a total of 5,674 articles (Figure 1). Following the removal of duplicate studies and having the remaining articles undergo an initial screening of titles and/or abstracts, ten articles were deemed eligible for inclusion. The appraisals for methodological quality was then completed using both the "Critical Appraisal Tool Checklist for Case Reports" and "Critical Appraisal Tool Checklist Case Series." Three articles were removed for not meeting the cut-off summary score of 5/7 and 4/9 respectively, leaving seven articles remaining for data extraction.

Appraisal

The average summary score for methodological quality of the seven studies included for the review for case reports and case studies were 5.5/7 and 7.5/9 respectively (Appendix A and B). For the case reports, the two commonly missed items of the quality appraisal tool were "Were adverse events (harms) or unanticipated events identified and described?" and "Was the patient's history clearly described and presented as a timeline?" Conversely, for the case series, the most commonly missed items of the quality appraisal tool were "Was there clear reporting of the demographics of the participants in the study?" and "Was there clear reporting of the presenting site(s)/clinic(s) demographic information?" Most studies included average daily pain as their primary outcome, while some also included range of motion and strength effects for the condition. For the studies that only looked at cadaver wrists, joint range of motion and joint space were the main outcomes recorded. There were no outcome measures that were used in every included study. This brings into question what the golden standard of measurement should be to truly measure effectiveness of treatment intervention outcomes for both surgical and conservative treatment methods for carpal bossing.

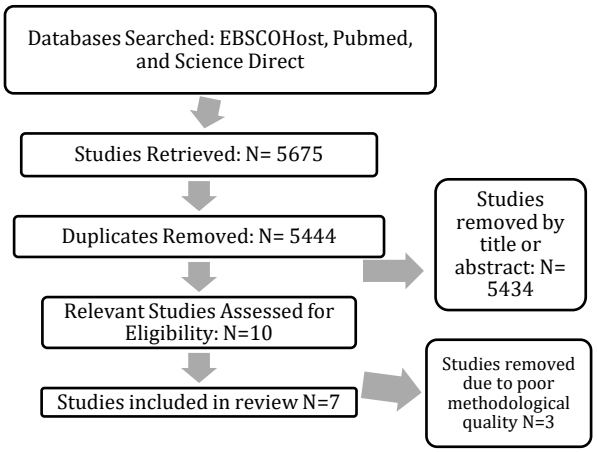

Figure 1. Search Diagram

INTERVENTIONS

Conservative Intervention

Of the studies included in this review, two studies examined the effects of a conservative treatment for carpal bossing.[9-10] Both studies included an immobilization period by bracing the wrist and the patients were instructed to take Non-Steroidal Anti-Inflammatory Drugs

(NSAIDs) to counteract the inflammation and pain caused by irritation. In the case study done by Boggess, et al.[9] the patient underwent a 4-week immobilization period and was completely pain free, 0/10 (on the Visual Analog Scale), at the end of the conservative treatment period. The patient in the study done by Kissel, et al. only completed two weeks of immobilization but had a rating of 0/10 pain after 1 week and was able to return to full participation in hockey.[10]

Surgical Intervention

The other five studies included in this review examined the effectiveness of a surgical intervention for the treatment and management of carpal bossing. While three articles looked at live subjects[11-13], the remaining two studied cadaver wrists that had undergone surgical wedge resection. [14-15] Boretto et al.[11] followed up with patients two years following their procedure and found all patients were able to return back to their activities of daily living (ADLs) and rated 0/10 for pain using the Visual Analog Scale. Similarly, Vieweg et al.[12] found seven out of eight of the surgical patients to be pain free, rated 0/10, at a two year follow up. It was noted that the eighth patient had been diagnosed with complex regional pain syndrome, which is thought to be the reason they were not pain free following the procedure (Table 2). Roulet et al.[13] studied twenty-four patients and had mixed findings with their results (Table 2).

The cadaver wrists that were studied were measured for joint angles, angular motion, and passive range of motion (PROM). Cittuer et al.[14] and Vermeulen et al.[15] both measured PROM, while one looked at joint angles and the other looked at angular motion, respectively. Citteur et al. discovered that joint angles were significantly increased (P values < 0.001). PROM or degrees of instability increased from 3 and 5 degrees to 7 and 11 degrees.[14] While Vermeulen et al. compared angular motion for wrists who had undergone different depths of wedge excisions (15%, 35%, and 55%).[15] It was found that joints who underwent a 55% wedge excision showed a significant increase in angular motion.

Author	Treatment Description	Participants	Outcomes & Findings
Bogges (2011)	Conservative	N=1, 36 y/o Male	Patient was pain free and had no complaints after 4 weeks of conservative treatment
Kissel (2009)	Conservative	N=1, 18 y/o Male Hockey Player	Patient rated 0/10 pain after 1 week and underwent 2 weeks of treatment. Patient was only symptomatic at end passive wrist flexion with direct pressure. Player played the rest of season for 2 months.
Boretto (2017)	Surgical	N=1, 61 y/o Female	2 year follow up the patient rated 0/10 pain, able to complete all ADLs, and was very satisfied.
Vieweg (2015)	Surgical	N=8, 3 Female, 5 Male	7 out of 8 patients were pain free at the 2 year follow up. The patient who was not pain free had been diagnosed with complex
Roulet (2017)	Surgical	N=25	None had recurrence of carpal bossing. Pain: 16/24 pts were pain free and the other 8 had an average pain of 2.3/10 (but all were attributed to weather changes). ROM: improved in 8 cases, unchanged in 11, and decreased in 5. Strength: Unchanged in 19/24, decreased in 4/24, and improved in 1/24
Citteur (1998)	Surgical	N=10, Cadaver Wrists	Joint angles were significantly increased (P values < 0.0001). PROM or degrees of instability increased from 5 and 5 degrees to 7 and 11 degrees.
Vermeulen (2009)	Surgical	N=12, Cadaver Wrists	Joints who underwent a 55% wedge excision showed a significant increase in angular motion

Table 2. Outcomes

DISCUSSION

The purpose of this systematic review was to analyze, consolidate, and evaluate the two different interventions used to treat carpal bossing. This condition can affect anyone, but has increased incidence in combat sport athletes, due to the repetitive close-fisted punching involved in their sport. It is commonly overlooked due to similarities to other more recurrent hand injuries, such as carpal tunnel syndrome or De Quervain's tenosynovitis.[2] If left untreated, carpal bossing can increase risk of injury to the hand due to bony and structural changes in this area. In result to the overlooking of this condition and the injury risk associated with it, this systematic review aimed to evaluate ways to treat carpal boss, which led to discovering the need for more standardized research.

Conservative treatment for carpal bossing typically includes an immobilization period, along with rest and NSAIDs, to help decrease pain, irritation, and inflammation. Similar conservative interventions are used for other common inflammatory or overuse wrist and hand injuries, such as carpal tunnel and De Quervain's tenosynovitis.[16-17] Due to the inflammatory nature of these conditions, immobilization and anti-inflammatory medications (NSAIDs or corticosteroids) are used for conservative management of symptoms. When compared to the results found for surgical intervention, the conservative method had longer lasting positive results, with patients not having recurring symptoms or consistent pain averaging 2/10 after the intervention, while surgical intervention caused a mixture of inconsistent results. Patients who underwent conservative treatment plans were able to return to full activity participation without complaints or recurrence.[9-10] Studies who looked at conservative treatments found that patients who underwent conservative treatments for carpal tunnel also had relief in symptoms, or at least a tolerable amount of symptoms, and an improvement of both neurological and functional deficits, including impaired sensation in the median nerve distribution or weakness of the thenar musculature.[18]

Surgical intervention for carpal bossing had various and inconsistent outcome measures, even years after the surgery was completed. Some studies found some patients who underwent surgery had complications years later and had painful and limited range of motion and strength deficits.[12-13] This is similar to the surgical outcomes for carpal tunnel, which is typically a release of the carpal tunnel ligament to allow more space in the carpal tunnel. While patients who undergo carpal tunnel release surgery are two times more likely to have relief of pain and restoration of nerve conduction, there are complications and side effects associated with this treatment.[19] There are mixed results and various outcome measures used for surgical interventions and the results are inconsistent for many surgical interventions. Shi et al. recommends doing conservative methods prior to trying surgery for cases that are considered mild to moderate, in which the patients have no functional or motion deficits.[19]

The articles reviewed in this study included both case studies and case series. Although both types of articles included in this review of are low level evidence, there are no high-level studies looking at treatment options for carpal bossing. Therefore, this limited information is what clinicians have available to make decisions in their practice. However, more research with larger groups of participants and more consistent results are needed to further understand the efficacy of these two treatment options. Due to the differences in studies, the outcome measures varied across the studies and were inconsistent in their reporting methods. Pain,

range of motion, joint angles, and strength were all outcome measures that were mentioned within the group of articles included in this review. The reporting method was inconsistent across the articles because no two articles reported the same outcome measure for their treatment (Table 2).

CLINICAL CONSIDERATIONS

Overall, the data found is level C evidence, according to the SORT, which must be taken into consideration when using it in a clinical setting. Randomized controlled trials are the golden standard within research and studies done on this topic should be designed in this manner to examine intervention outcomes. While this low level of evidence may make it difficult to truly trust the intervention outcomes, this is the only evidence available for considering them in clinical practice. There is a wide array of reported measurements, but they are not consistent across many studies, so they are difficult to compare to one another. However, it was shown that conservative management allowed patients to return to full pain-free function, while surgical interventions had mixed results, some positive and some negative. Though these initial findings suggest conservative management may be a better option, the varied time frames and reporting in these studies limit the comparability between findings. This information can be used when making clinical decisions, but other factors need to be considered when creating a treatment plan for patients with this condition. Clinicians should still be mindful of this information with consulting with patients and should take this evidence into consideration when discussing what the patient wants and what they can afford.

This systematic review shows a need for more research to be conducted on this topic to gain a better understanding of the effectiveness of interventions used to treat carpal bossing. If left untreated the individual is at a higher risk of many other injuries or pathologies affecting the hand and wrist. Standardized research methods and outcome measures need to be more fully developed to better understand outcomes of treatment options and their long-term effects so patients can have this condition treated properly

CONCLUSION

The limited evidence suggests conservative management may reduce pain and improve clinical outcomes. However, clinicians should consider the level C evidence with skepticism as the quality of evidence on this topic is low. Further investigations should be performed with more rigor.

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Appendix A. Summary Scores of the Critical Appraisal for Case Studies

	Boretto	**Kissel**	**Boggess**
Were the patient's demographic characteristics clearly described?	Y	Y	Y
Was the patient's history clearly described and presented as a timeline?	Y	Y	N
Was the current clinical condition of the patient on presentation clearly described?	Y	Y	Y
Were the diagnostic tests or assessment methods and the results clearly described?	Y	Y	Y
Was the post-intervention clinical condition clearly described?	Y	Y	Y
Were adverse events (harms) or unanticipated events identified and described?	N	N	N
Does the case report provide takeaway lessons?	Y	Y	Y
Total	6/7	6/7	5/7

Appendix B. Summary Scores of the Critical Appraisal for Case Series

	Citteur*	Roulet	Bhure	Vermeulen*	Alemohammad*	Vieweg	Lui
Were there clear criteria for inclusion in the case studies?	Y	Y	Y	Y	N	Y	N
Was the condition measure in a standard, reliable way for all participants?	Y	Y	N	Y	N	Y	N
Were there valid methods used for identification of the condition for all participants included in the case series?	Y	Y	Y	N	N	Y	N
Did the case series have complete inclusion of participants?	Y	Y	N	N	N	Y	N
Was there clear reporting of the demographics of the participants in the study?	N	Y	N	N	N	Y	N
Was there clear reporting of clinical information of the participants?	N	Y	Y	N	N	Y	N
Were the outcomes or follow up results of cases clearly reported?	Y	Y	N	Y	Y	Y	N
Was there clear reporting of the presenting site(s)/clinic(s) demographic information?	Y	N	N	N	N	N	N
Was statistical analysis appropriate?	Y	Y	Y	Y	Y	Y	N
Total Score	7/9	8/9	4/9	4/9	2/9	8/9	0/9

*Cadaver Wrists