Temporomandibular Joint Arthroscopic Findings in Patients With Cervical Flexion–Extension Injury (Whiplash): A Preliminary Study of 30 Patients

• Hani Abd-Ul-Salam, BSc, MSc, DDS, PhD, OMFSA •
• Bohdan Kryshtalskyj, BSc, DDS, MRCD(C) •
• Simon Weinberg, DDS, FRCD(C) •

Abstract

Purpose: *To investigate arthroscopic findings for the temporomandibular joint (TMJ) in 30 patients with refractory TMJ symptoms who had suffered cervical flexion–extension injury (whiplash).*

Methods: *The clinical data and operative reports of all patients with a diagnosis of TMJ whiplash injury who underwent TMJ arthroscopic procedures from 1997 to 2002 were reviewed. All patients underwent preoperative clinical, panoramic, arthrographic, magnetic resonance imaging evaluation or computed tomography (or some combination). The same surgical team performed all diagnostic and therapeutic arthroscopic procedures in patients for whom conservative therapy had failed. Before the arthroscopic surgery, all of the patients had received at least 3 to 6 months of nonsurgical therapy consisting of anti-inflammatory medications, muscle relaxants, splint therapy, physiotherapy (specifically transcutaneous electrical nerve stimulation, moist heat, cold laser, and ultrasonography) and a soft diet.*

Results: *A spectrum of arthroscopic findings, ranging from chondromalacia (softening of the articular fibrocartilage) to moderate or severe synovitis and adhesions, was observed, as well as combinations of these abnormalities.*

Conclusion: *The primary intracapsular pathologic changes observed during TMJ arthroscopic examination of 30 patients who suffered cervical whiplash injury appear to be nonspecific, varying along a wide spectrum of findings.*

MeSH Key Words: *arthroscopy; temporomandibular joint disorders/etiology; whiplash injuries/complications*

© J Can Dent Assoc 2002; 68(11):693-6
This article has been peer reviewed.

Temporomandibular disorder is a collective term for a group of conditions involving the temporomandibular joint (TMJ), the muscles of mastication and associated structures. These disorders are relatively common, affecting at least 30% of the population,[1] and they can be classified as having a muscular origin, being restricted to the intra-articular apparatus of the TMJ or a combination thereof. The findings may result from intra-articular adhesions. Such adhesions may form as a result of increased friction on the articular surface and lack of effective lubrication precipitated by trauma, intracapsular bleeding and effusion resulting from microtrauma or a macrotraumatic event. An objective classification of intra-articular disease has been described by Wilkes,[2] who classified internal derangements into various stages ranging from normal articular surfaces to severe degenerative osseous changes. Bronstein enriched this classification by providing arthroscopic details.[3] Motor vehicle collisions (MVCs) are relatively common in industrialized countries and in many cases have been implicated as a direct or indirect cause of whiplash.[4] The term "whiplash" refers to cervical flexion–extension head injury that occurs most frequently after rear-end or lateral MVCs.[5–7] During an MVC the torso usually moves forward relative to the head and neck. This differential movement results in relative hyperextension of the head at the atlanto-occipital junction. There is also a differential movement of the mandible relative to the cranium, which results in extensive mouth opening and hypertranslation of the disk–condyle complex.[8,9]

The treatment options for patients with temporomandibular disorders can range from conservative to surgical modalities.[10] Nonsurgical therapy may include anti-inflammatory medications, muscle relaxants, splint therapy, exercise, physiotherapy (including moist heat, cold laser and ultrasonography) and a soft diet or some combination of these strategies. Surgical therapy ranges from minimally invasive procedures such as arthroscopy to a variety of open-joint procedures. Before the advent of TMJ arthroscopic surgery, many patients whose condition did not improve with conservative treatment underwent open-joint arthrotomy according to the severity of internal derangement or degenerative joint disease and their level of discomfort.[11]

Since the introduction of arthroscopic TMJ surgery,[12] many reports have documented beneficial results with low morbidity.[13–21] Arthroscopy has the distinct advantage of allowing direct visualization of the TMJ and fulfills not only a therapeutic role but also a diagnostic one.[18,19] It also allows for lysis and lavage procedures under direct vision, as well as guided steroid injections. Favourable outcomes of operative TMJ arthroscopy have been reported in 60% to 90% of cases, depending on the type of internal derangement.[22–27] Diagnostic arthroscopic staging of internal derangements correlating with Wilkes's classification was expanded by Bronstein.[3] In this system, the internal derangements are divided into 5 stages. The earliest stage (stage I) is characterized by 80% roofing (i.e., the extent to which the cartilaginous disk is covering the condyle) of the fibrous disk in the closed-mouth position to 100% roofing in the open-mouth position. Stage II exhibits early adhesive synovitis with 50% roofing in the closed-mouth position. Stage III is characterized by loss of flexure and redundancy. Stage IV is characterized by fibrillations, furrowing, cratering and exposure of bone. The most advanced stage, stage V, is characterized by prominent fibrillations, perforation, retrodiskal hyalinization and advanced synovitis, along with bone exposure and cratering.

This article describes the arthroscopic TMJ findings for 30 patients who suffered cervical whiplash injury and experienced refractory TMJ pain and dysfunction.

Methods

Operative records were reviewed for 30 consecutive patients who presented with TMJ pain and dysfunction and a history of cervical whiplash injury related to an MVC and who underwent surgical arthroscopy between 1997 and 2002. All patients had undergone a preoperative clinical examination and panoramic radiography, and selected patients had undergone additional diagnostic imaging, such as arthrography, magnetic resonance imaging or computed tomography. All patients had persistent painful TMJ symptoms following at least 3 to 6 months of conservative therapy consisting of anti-inflammatory medications, muscle relaxants, splint therapy, exercise, physiotherapy (specifically transcutaneous electrical nerve stimulation, moist heat, cold laser, and ultrasonography) and a soft, nonchewy diet. None of the patients in the study had underlying arthritides, all were classified as healthy, with no or mild systemic disease, and none had any complaints of jaw pain before the MVC. All patients underwent operative arthroscopy of the TMJ. Patients who had previously undergone arthroscopic TMJ procedures and those who had a temporomandibular disorder before the MVC were excluded. The same team of surgeons carried out all arthroscopic procedures (described below). Immediately after the surgery, patients started a regular regimen of physiotherapy and adjunctive active jaw exercises to be performed at home.

All patients underwent double-portal operative arthroscopy consisting of adhesiolysis, lavage and manipulation, and debridement of the superior joint space. Where indicated, abrasion arthroplasty or partial synovectomy or lateral capsular release with subsynovial injection of steroids under direct arthroscopic guidance (or some combination of these procedures) was also performed.

Results

The patients ranged in age from 25 to 57 years (mean 35.7 years). The sample consisted of 17 men (57%) and 13 women (43%). The mean period between the injury and the arthroscopic procedure was 2 years. Most of the patients (27 or 90%) had disk displacement without reduction. Fourteen (47%) of the patients had grade II–III chondromalacia (Fig. 1), whereas 16 (53%) had grade III–IV chondromalacia (Fig. 2). Synovial hyperplasia was observed in 2 cases (Fig. 3). Synovitis occurred in 22 (73%) of the patients, but severe synovitis was rare (2 cases or 7%). In addition, 20 (67%) of the joints had mild to severe adhesions. Most of the adhesions were restricted to the anterior pouch and the intermediate zone (Fig. 4). In many cases the disk was fibrotic and relatively immobile. Twenty-four (80%) of the joints showed mild to severe hyperemia and hypervascularity (Fig. 5). In 21 (70%) of the patients, posterior attachment petechiae were noted (Fig. 6). Synovial hyperplasia and inflammation, as well as creeping synovitis, were observed in 23 (77%) of the patients (Figs. 7, 8).

Discussion

Whiplash or cervical flexion–extension injury is a relatively common result of MVCs. Some patients with this type of injury have reported symptoms of temporomandibular disorder that were not present before the MVC.[4–9] It has been suggested that hyperextension of the neck around a fulcrum, with a delay in suprahyoid elongation, combined with differential inertia between the

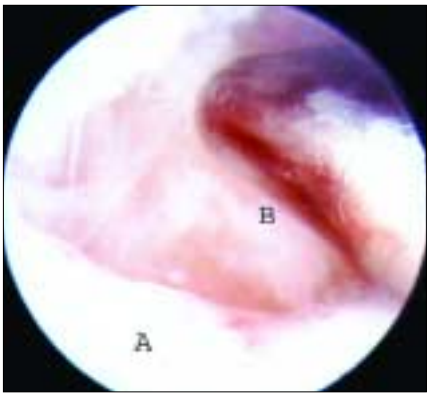

Figure 1: *Arthroscopic view of the TMJ showing moderate chondromalacia (grade II–III). The disk (A) and cartilage (B) are evident.*

Figure 2: *Arthroscopic view of the TMJ showing severe chondromalacia (grade III–IV). The disk (A) and cartilage (B) are evident.*

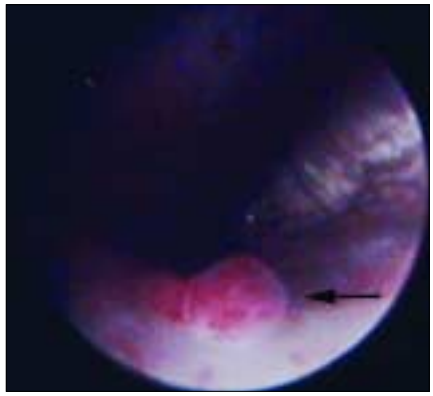

Figure 3: *Arthroscopic view of the TMJ showing a synovial hyperplastic polyp (arrow).*

Figure 4: *Arthroscopic view of the TMJ showing "guitar string" adhesions (arrow) in the medial capsule of the superior joint space. The articular eminence (E) and the disk (D) are visible.*

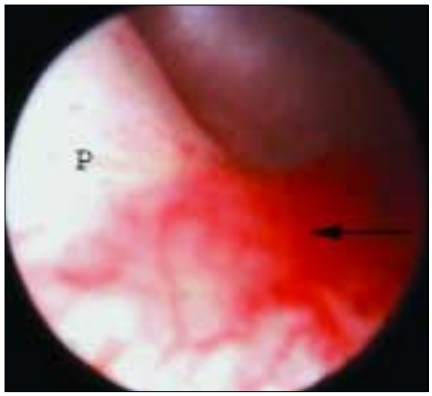

Figure 5: *Arthroscopic view of the TMJ showing severe synovitis, including hyperemia, hypervascularity and creeping synovitis (arrow). The area of the posterior attachment (P) is also evident.*

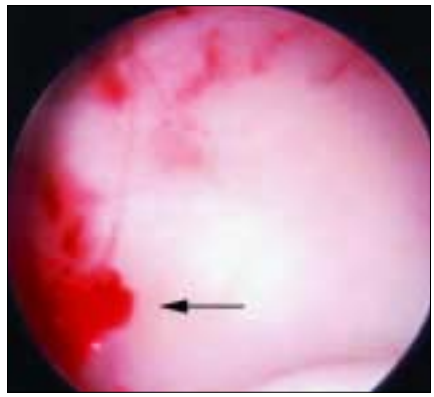

Figure 6: *Arthroscopic view of the TMJ showing petechial hemorrhage (arrow) in the medial capsule.*

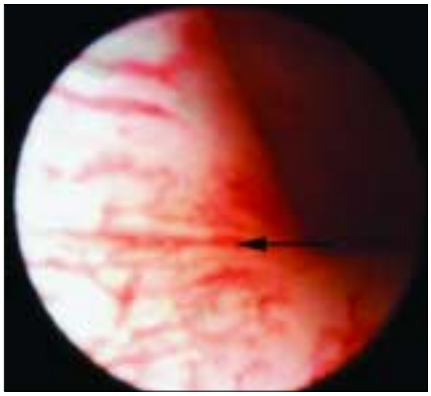

Figure 7: *Arthroscopic view of the TMJ showing creeping synovitis. Arteriolar dilatation is visible on the disk (arrow).*

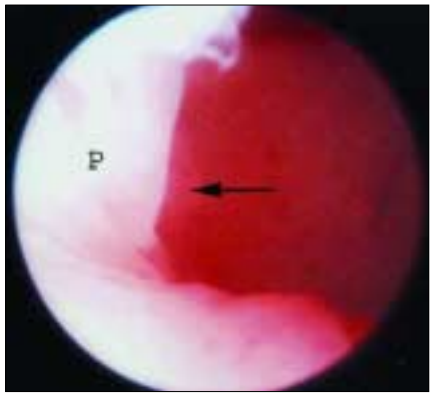

Figure 8: *Arthroscopic view of the TMJ showing hyperplastic synovium (arrow). The area of the posterior attachment (P) is also visible.*

mandible and the cranium, ultimately leads to hypertranslation of the condyle and the disk.[4–9]

The surgical options for the treatment of painful, refractory internal derangements of the TMJ include arthrocentesis, arthroscopic surgery, disk placation, diskectomy and condylotomy. In this study, TMJ arthroscopic findings were reviewed for patients with a history of whiplash whose condition failed to improve after a reasonable course of appropriate nonsurgical therapy. In the authors' experience, 74% of patients with whiplash improved, while 26% of these patients who failed nonsurgical management subsequently underwent arthroscopic surgical procedures.

Results of this study revealed a wide range of arthroscopic observations, including synovitis, adhesions, chondromalacia or a combination thereof. These changes are nonspecific and are identical to those found in patients with varying stages of degenerative joint disease. One possible explanation for the fact that post-whiplash TMJ

injuries resemble degenerative arthritis arthroscopically is that some of these patients may have had asymptomatic degenerative joint disease with chronic changes in the joint, and that this silent pre-existing condition was acutely exacerbated with the onset of pain after cervical whiplash injury.

Another explanation for these TMJ intracapsular findings is the time elapsed between the whiplash injury and the arthroscopic surgery (mean time of 2 years). During this period the acute whiplash injury may have led to the development of chronic changes within the TMJ.

Lastly, this study did not attempt to compare findings in patients with whiplash to findings in patients with non-whiplash injury. The authors did not examine the variables that could have resulted in the findings observed. However, other studies in progress are examining these variables and will be the subject of a future article. Prospective controlled studies with larger groups of patients are warranted. ◆

Acknowledgment: This article is based on a presentation given at the Annual Scientific Conference of the Canadian Association of Oral and Maxillofacial Surgeon, London, Ontario, June 2002.

Dr. Abd-Ul-Salam is an assistant professor, department of oral and maxillofacial surgery, faculty of dentistry, King Faisal University, Khobar, Kingdom of Saudi Arabia and research fellow, department of oral and maxillofacial surgery, faculty of dentistry, University of Toronto, Toronto, Ontario.

Dr. Kryshtalskyj is chief, department of oral and maxillofacial surgery and dentistry, Trillium Health Centre; associate staff, department of oral and maxillofacial surgery, faculty of dentistry, University of Toronto; active staff, Toronto General Hospital, University Health Network, Toronto, Ontario.

Dr. Weinberg is a professor emeritus, department of oral and maxillofacial surgery, faculty of dentistry, University of Toronto; active staff, Toronto General Hospital, University Health Network, Toronto, Ontario.

Correspondence to: Dr. Hani Abd-Ul-Salam, Toronto General Hospital, Department of Oral and Maxillofacial Surgery, EN 10-236, 200 Elizabeth St., Toronto, ON M5G 2C4. E-mail: haniomfs@hotmail.com.

The authors have no declared financial interests.

References

1. Greene CS, Marbach JJ. Epidemiologic studies of mandibular dysfunction: a critical review. *J Prosthet Dent* 1982; 48(2):184–90.

2. Wilkes CH. Internal derangement of the temporomandibular joint. Pathologic variations. *Arch Otolaryng Head Neck Surg* 1989; 115(4):469–77.

3. Bronstein S. Arthroscopy: Historical perspectives and indications. *Oral Maxillofac Surg Clinics North Am* 1989; 1(2):59–68.

4. Epstein JB. Temporomandibular disorders, facial pain and headache following motor vehicle accidents. *J Can Dent Assoc* 1992; 58(6):488–9, 493–5.

5. Kasch H, Hjorth T, Svensson P, Nyhuus L, Jensen TS. TMD after whiplash injury: a controlled, prospective study. *J Orofac Pain* 2002; 16(2):118–28.

6. Bergman H, Andersson F, Isberg A. Incidence of temporomandibular joint changes after whiplash trauma: a prospective study using MR imaging. *Am J Roentgenol* 1998; 171(5):1237–43.

7. Burgess JA, Kolbinson DA, Lee PT, Epstein JB. Motor vehicle accidents and TMDS: assessing the relationship. *J Am Dent Assoc* 1996; 127(12):1767–72

8. Brady C, Taylor D, O'Brien M. Whiplash and temporomandibular joint dysfunction. *J Ir Dent Assoc* 1993; 39(3):69–72.

9. Weinberg S, Lapointe H. Cervical extension-flexion injury (whiplash) and internal derangement of the temporomandibular joint. *J Oral Maxillofac Surg* 1987; 45(8):653–6.

10. Weinberg S, Kryshtalskyj B, Psutka D, Lamantia P. Operative arthroscopy of the temporomandibular joint. *Oral Health* 1992; 82(5):11–4, 16, 18–20.

11. Sanders B. Management of internal derangements of the temporomandibular joint. *Semin Orthod* 1995; 1(4):244–57.

12. Ohnishi M. Arthroscopy of the temporomandibular joint. *Kokubyo Gakkai Zasshi* 1975; 6(4):207–13.

13. McCain JP, de la Rua H, LeBlanc WG. Puncture technique and portals of entry for diagnostic and operative arthroscopy of the temporomandibular joint. *Arthroscopy* 1991; 7(2):221–32.

14. McCain JP, Sanders B, Koslin MG, Quinn JH, Peters PB, Indresano AT and other. Temporomandibular joint arthroscopy: a 6-year multicenter retrospective study of 4,831 joints. *J Oral Maxillofac Surg* 1992; 50(9):926–30.

15. Carls FR, Engelke W, Locher MC, Sailer HF. Complications following arthroscopy of the temporomandibular joint: analysis covering a 10-year period (451 arthroscopies). *J Craniomaxillofac Surg* 1996; 24(1):12–5.

16. Sanders B. Arthroscopic surgery of the temporomandibular joint: treatment of internal derangement with persistent closed lock. *Oral Surg Oral Med Oral Pathol* 1986; 62(4):361–72.

17. Goss AN, Bosanquet AG. Temporomandibular joint arthroscopy. *J Oral Maxillofac Surg* 1986; 44(8):614–7.

18. Murakami K, Lizuka T, Matsuki M, Ono T. Diagnostic arthroscopy of the TMJ: differential diagnoses in patients with limited jaw opening. *Cranio* 1986; 4(2):117–26.

19. Murakami K, Ono T. Temporomandibular joint arthroscopy by inferolateral approach. *Int J Oral Maxillofac Surg* 1986; 15(4):410–7.

20. McNamara DC, Rosenberg I, Jackson PA, Hogben J. Efficacy of arthroscopic surgery and midlaser treatments for chronic temporomandibular joint articular disc derangement following motor vehicle accident. *Aust Dent J* 1996; 41(6):377–87.

21. Perrott DH, Alborzi A, Kaban LB, Helms CA. A prospective evaluation of the effectiveness of temporomandibular joint arthroscopy. *J Oral Maxillofac Surg* 1990; 48(10):1029–32.

22. Rosenberg I, Goss AN. The outcome of arthroscopic treatment of temporomandibular joint arthropathy. *Aust Dent J* 1999; 44(2):106–11.

23. Israel HA. Part I: The use of arthroscopic surgery for treatment of temporomandibular joint disorders. *J Oral Maxillofac Surg* 1999; 57(5):579–82.

24. Indresano AT. Arthroscopic surgery of the temporomandibular joint: report of 64 patients with long-term follow-up. *J Oral Maxillofac Surg* 1989; 47(5):439–41.

25. White RD. Retrospective analysis of 100 consecutive surgical arthroscopies of the temporomandibular joint. *J Oral Maxillofac Surg* 1989; 47(10):1014–21.

26. Sanders B, Buoncristiani R. Diagnostic and surgical arthroscopy of the temporomandibular joint: clinical experience with 137 procedures over a 2-year period. *J Craniomandib Disord* 1987; 1(3):202–13.

27. Mosby EL. Efficacy of temporomandibular joint arthroscopy: a retrospective study. *J Oral Maxillofac Surg* 1993; 51(1):17–21.