Glenoid Hypoplasia: A Report of 2 Patients

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Abstract

Objective: This article discusses the imaging findings, clinical findings, and conservative chiropractic management of 2 patients with glenoid hypoplasia.

Clinical Features: Conventional radiographs of both patients revealed a hypoplastic glenoid bilaterally. Notch-like defects along with signs of degenerative disease were evident within the lower portion of the glenoid rims bilaterally in 1 patient and in the left glenoid rim of the other patient. Magnetic resonance imaging revealed a degenerative cyst or cortical defect in one patient along the anterior humeral head. The second patient showed a small slightly lobulated cystic region just posterior to the glenoid rim, consistent with the appearance of a synovial or ganglion cyst. Computed tomography with 3-dimensional reconstruction in 1 patient confirmed the presence of large posterior and superior osteophytes arising from the significantly hypoplastic glenoid. These images also revealed a slight posterior subluxation of the humeral head, widening of the anterior glenohumeral joint space, and retroversion of the glenoid.

Intervention and Outcome: Treatment consisted of manual joint manipulation, soft tissue therapies, and therapeutic exercise for both patients. Both patients experienced improvements in symptoms, function, and physical examination findings.

Conclusions: Glenoid hypoplasia is a developmental anomaly of the scapular neck which is predominantly bilateral and symmetric. Cross-sectional imaging studies should be considered in patients with symptoms that fail to improve over time. Conservative chiropractic care may be effective in managing symptoms in patients with glenoid hypoplasia.

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Key Indexing Terms: *Hypoplasia; Scapula; Shoulder; Chiropractic*

Hypoplasia and dysplasia of the glenoid neck are general terms to describe a developmental anomaly of the scapula comprising incomplete ossification of the lower two thirds of the scapular glenoid and adjacent neck with associated cartilaginous changes.[1] More than 100 cases of glenoid hypoplasia have been reported in the literature.[1] Glenoid hypoplasia was initially believed to be relatively rare.[2] However, recent literature indicates it is potentially more common than early estimates suggest.[2] Many reported cases are actually discovered incidentally in asymptomatic individuals, contributing to the uncertainty of its true prevalence.[3] Glenoid hypoplasia is usually bilateral and symmetric, but unilateral cases have occasionally been reported.[2,4] Additional findings include widening of the glenohumeral joint space, hypertrophied posterior glenoid labrum, notched or indented surface of the glenoid (dentate glenoid), hyperplastic coracoid process, a large and elongated acromion, hooking of the distal end of the clavicle, and hypoplasia of the humeral head.[1,2,5] Although patients are often asymptomatic, they may experience symptoms such as decreased range of motion, pain, and stiffness.[1,2] Although some authorities suggest instability is uncommon with glenoid hypoplasia, others have reported a correlation.[6,7] Early degenerative changes related to irregularity of the articular surface of the glenoid may complicate the condition.[1] We present two cases of glenoid hypoplasia demonstrating typical imaging findings that were managed by conservative chiropractic care.

Case Report

Patient 1

History. A 27-year-old male chiropractic student presented with a 10-year history of intermittent, bilateral local anterior shoulder pain. The pain which was reported, at worst, a 9/10 on a numeric pain scale was exacerbated by overhead activities, particularly while lifting weights. The patient

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Table 1. *Orthopedic tests referred to in the text*

Orthopedic test	Procedure	Interpretation of Positive Finding
Abbott Saunder's Test	Patient seated, the examiner fully abducts and externally rotates the patient's arm. The examiner then lowers the arm to the patient's side.[8]	An audible click indicates subluxation of the biceps tendon.[8]
Apley's Scratch Test	Patient is seated and instructed to place the affected hand behind the head and touch the opposite superior angle of the scapula. The patient is then instructed to place the hand behind the back and attempt to touch the opposite inferior angle of the scapula.[8]	Exacerbation of patient's pain is indicative of degenerative tendinitis of one of the tendons of the rotator cuff, usually supraspinatus.[8]
Apprehension Test	Patient is supine with the affected arm in external rotation and abduction. The examiner pushes anteriorly on the posterior humeral head.[9]	Positive finding is apprehension in the patient's demeanor coupled with pain indicating possibility of recurrent dislocations.[9]
Empty Can (Supraspinatus Strength Test)	Seated patient abducts the shoulder to 90° and the examiner resists the abduction. The shoulders are medially rotated and angled 30° forward and the examiner resists abduction.[10]	Weakness or pain indicates a lesion of the supraspinatus rotator cuff muscle.[10]
Full Can Test	Patient's arm is abducted to 90° in the scapular plane, and externally rotated 45°. This position is held against a downward resistance.[10]	Weakness or pain indicates supraspinatus lesion.[10]
Gerber's Lift Off	Patient's arm is internally rotated with the forearm/dorsum of hand placed against the lower back.[11]	The inability of the patient to lift the hand posteriorly off of the back or hold the arm in a position just off the low back indicates subscapularis tendon pathology.[11]
Hawkins' Impingement Sign/Test	Patient's arm is placed in 90° on forward flexion with the elbow flexed at 90°. The examiner internally rotates the arm maximally.[11]	Reproduction of pain indicates a subacromial impingement and rotator cuff pathology.[11]
Jobe's Test	Patient is seated with arm is raised to 90° in the scapular plane (roughly 30° forward), with the thumbs pointing toward the ground. This position is held against a downward resistance.[11]	This test is an indication of rotator cuff, particularly supraspinatus pathology.[11]
Load and Shift Test	Examiner stands behind affected side and places hand over the patient's scapula to stabilize. With the opposite hand, the examiner grasps the humeral head while applying an anterior and a posterior force. Then, a downward traction of the humerus is applied and the area adjacent to the acromion is observed.[9]	If present, the amount of translation between the arch of the acromion and head of the humerus is reported in centimeters.[9]
Neer's Impingement Sign	The examiner raises patient's affected arm into forward elevation (somewhere between flexion and abduction) with one hand, while the other hand is placed on the patient's shoulder immobilizing the scapula for support.[11]	Pain and weakness is noted at the degree of forward flexion, which may indicate impingement syndrome.[11]
Relocation Test	Patient is supine with the affected arm in external rotation and abduction. The examiner pushes posteriorly on the anterior aspect of the humeral head.[9]	Patients with instability or secondary impingement will have a relief of symptoms.[9]
Speed's Test	The patient's shoulder is flexed to 90° with elbow extended. The patient further resists forearm supination and elbow extension.[8]	Increased tenderness in the bicipital groove suggesting bicipital tendonitis.[8]
Sulcus Sign	Patient sits with arms relaxed at the side of the body. A downward axial force is applied along the humerus by holding the elbow.[9]	The sign appears between the arch of the acromion and head of the humerus, indicating capsular laxity as well as testing the superior glenohumeral and coracohumeral ligaments.[9]
The Crank (Apprehension) Test	Patient is seated with arm elevated to 160° in the scapular plane with an axial traction applied to the humerus with one hand. The examiner's other hand produces internal and external rotation of the humerus.[9]	Pain with the maneuver with or without an audible click potentially indicates a lesion of the labrum or instability.[9]

reported a history of training with heavy weights (whole body) from ages 13 to 25 with weight upwards of one repetition of 500 lb on bench press and 20 repetitions of 315 lb for a continuous 4- to 5-year period. From ages 16 to 23 years, he competed as a power lifter, training with near 1-rep-maximum weights frequently. During that time, he experienced no pain if the elbows were kept at the sides of his body during the lifts. Most pain occurred with throwing movements and dynamic overhead activities (painting, put dishes away, etc), but there was no pain weight lifting under controlled execution. Weight-training also elicited crepitus within both shoulder joints.

The right shoulder pain initially began 10 years earlier after the repetitive microtrauma of throwing javelin. No diagnosis was established at the time, but after 4 weeks of rehabilitation by his chiropractor, there was a complete remission of symptoms. The left shoulder pain began 8 years earlier after being tackled in football. Conventional radiographs obtained at the time were reported as normal and rehabilitation was successful in alleviating the pain at the time. He now reports compensating with active bracing and shoulder retraction during activities of daily living, a measure that seems to prevent pain.

Examination Findings. Physical examination revealed slightly limited active ranges of motion in forward flexion, abduction, adduction, and internal rotation of both shoulders. Forward flexion produced anterior shoulder pain bilaterally and external rotation at 90° of abduction produced posterior-sided shoulder pain on the right. The following orthopedic tests were performed (Table 1): Apley's scratch test revealed internal rotation to T12 and external rotation to T3 bilaterally; Speed's Test produced anterolateral shoulder pain bilaterally; Codman's drop arm sign was absent bilaterally; Full Can and Empty Can tests were positive bilaterally with right-sided pain greater than left; Hawkins' Impingement Sign; Gerber's Lift Off test was positive indicating a weak subscapularis muscle and a tight posterior glenohumeral joint capsule bilaterally; Jobe's Test produced pain in the anterior shoulder bilaterally with audible crepitus in left shoulder; bilateral apprehension and relocation tests were positive producing pain and indicating subtle anterior glenohumeral instability; Sulcus Sign was evident bilaterally; Load and Shift Test was noted as a 2 anterior bilaterally and a 2 posterior bilaterally. These findings collectively indicate a secondary impingement syndrome or injury or pathology of the rotator cuff, biceps tendon, or ligaments about the shoulder.

Imaging Findings. Conventional radiographs of both shoulders (Fig 1) revealed normal alignment with no evidence of acromioclavicular joint degeneration. The glenoid processes appeared hypoplastic bilaterally and notch-like defects were apparent within the lower portion of the glenoid rims. Osteophytes arising from the inferior aspect of both glenoid rims were barely visible but were indicative of early degenerative disease. Both humeral heads appeared somewhat hypoplastic and exhibited minimal subchondral sclerosis.

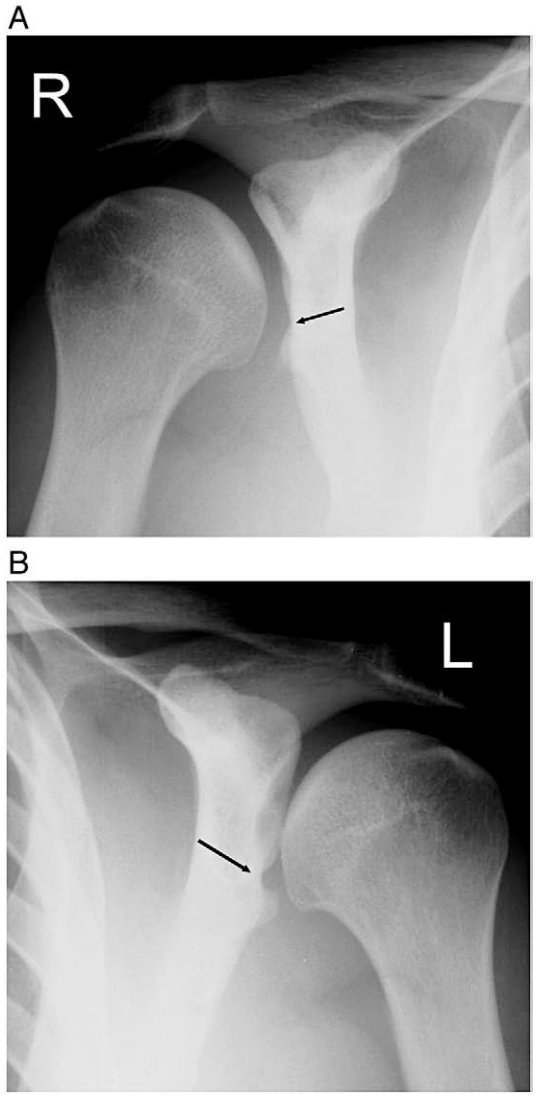


Fig 1. *Patient 1: internal rotation radiographs of the right (A) and left (B) shoulder reveal marked hypoplasia of the glenoid necks bilaterally and irregular, dentate or notched articular surface (arrows) of the left glenoid cavity.*

Magnetic resonance (MR) images of the left shoulder (not shown) revealed a markedly dysplastic appearance with flattening of the glenoid fossa and a dentate notch in the glenoid rim. Prominent posterior marginal osteophyte formation and minimal anterior osteophyte formation was present. The glenoid version was negative 50°, which is markedly abnormal and prone to instability and dislocation. Along the anterior humeral head, there was either an incidental degenerative cyst or cortical defect possibly from a prior dislocation. There was no evidence of rotator cuff or biceps tendon pathology. Computed tomography (CT) with 3-dimensional reconstruction was then ordered to

further evaluate the dysplastic scapula and to further assess the degenerative changes. These images (Fig 2) confirm the presence of large posterior and superior osteophytes arising from the significantly hypoplastic glenoid. These images also revealed a slight posterior subluxation of the humeral head, widening of the anterior glenohumeral joint space, and retroversion of the glenoid.

Management and Outcome. Conservative management included a protocol of proprioceptive stretching and strengthening of the rotator cuff musculature. The patient complied with all instructions. The following treatments were performed once per week over a 7-week period. Soft tissue modalities included Active Release Technique (ART) and Nimmo techniques of the shoulder musculature, bilaterally once per week. In this particular case, ART and Nimmo were used to treat the muscular dysfunction associated with the congenital malformation of the glenoid. Rhythmic stabilization of the shoulders was also performed bilaterally. After 4 weeks of treatment, the patient reported a significant subjective decrease in symptoms. A 6-week reassessment revealed full and pain-free active and passive ranges of motion bilaterally. Orthopedic tests revealed the same positive findings as upon initial evaluation with the exception of Full Can, Empty Can, and Speed's, which were less painful as reported by the patient. After 7 weeks, the symptoms had subsided completely with 100% reduction of pain, and full, pain-free active and passive ranges of motion.

Patient 2

History. A second chiropractic student, a 24-year-old man, complained of localized left anterior shoulder pain of three months' duration after performing a chiropractic manipulation procedure on a classmate in technique class. The pain was reported as a three to four at its worst on a 10-point numeric pain scale and was exacerbated by overhead activities, particularly in external rotation and abduction and while lifting weights. His weight lifting routine 3 times per week included military and bench press with 150 and 300 lb respectively. This injury appeared to be an acute exacerbation of an injury that occurred in a collision during a football game 4 years earlier. At that time, the injury was diagnosed as tendinitis and was treated with electrical stimulation, stretching and shoulder exercises 6 times in 3 weeks by a chiropractor. After this treatment, the patient reported a complete resolution of the symptoms.

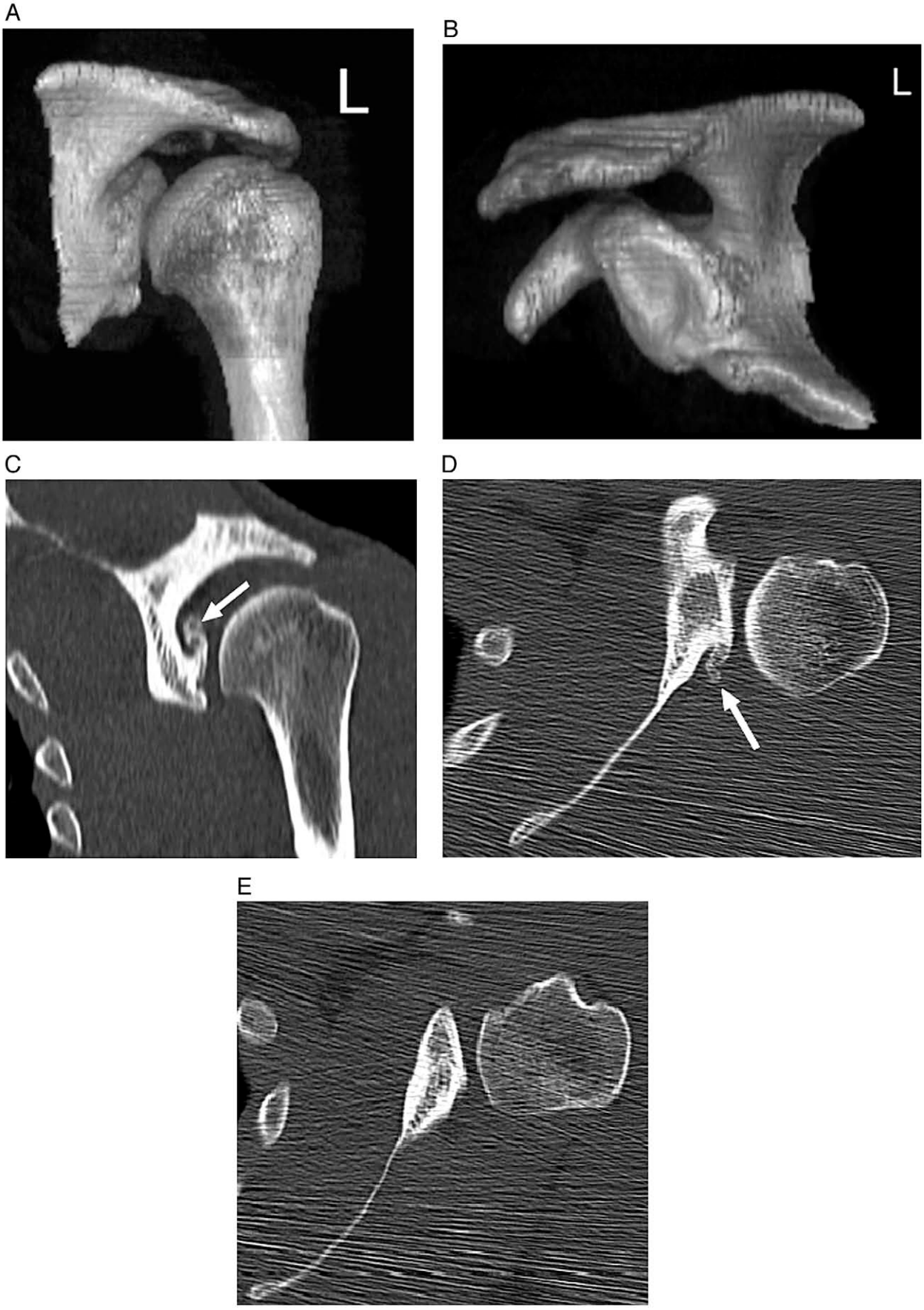
Examination Findings. Examination of the left shoulder revealed slightly limited active and passive flexion and external rotation of the left shoulder. The following orthopedic provocative maneuvers reproduced the patient's complaint of left anterior shoulder pain. Neer's Impingement Sign was painful at end range forward flexion, indicative of internal glenoid impingement; the Relocation Test relieved the complaint of anterior shoulder pain, which is indicative of anterior shoulder instability; The Crank (Apprehension) Test reproduced the anterior shoulder pain, indicative of anterior shoulder instability; Apley's Scratch Test was painful in both external rotation and internal rotation suggesting rotator cuff pathology; pain and an audible click were elicited past 90° of abduction upon performance of Abbott-Saunder's test indicative of a possible subluxation of the biceps tendon and/or bicipital tenosynovitis.

Imaging Findings. Conventional radiographs (Fig 3) revealed bilateral hypoplastic glenoids and humeral heads. A small notch was evident inferiorly in the articular surface of the left glenoid rim. A curvature of the underside of each acromion (type II acromion)[1] was noted bilaterally. These findings are consistent with classic glenoid hypoplasia.

Bilateral shoulder MR images (Fig 4) confirmed the presence of hypoplastic glenoid, worse on the left. The left glenoid was somewhat smaller than normal, especially the posterior portion of the bone. The posterior glenoid labrum is not discretely identified but the anterior glenoid labrum appears unremarkable. There is a small slightly lobulated cystic area measuring 1 × 1.5 cm just posterior to the glenoid rim consistent with the appearance of synovial cyst or ganglion cyst. The humeral head is also somewhat hypoplastic. MR images of the right shoulder (not shown) revealed similar findings. The rotator cuff and biceps tendons were intact.

Management and Outcome. Active mobilization of the acromioclavicular and glenohumeral joints, as well as ART of associated muscular dysfunction was administered once per week for 5 weeks. Home instructions included tubing exercises for the rotator cuff as well as shoulder isotonic internal and external rotation daily exercises including thirty repetitions of a 3-second concentric contraction and a 6-second eccentric relaxation. A 5-week reassessment included orthopedic testing of the left shoulder which exhibited full range of motion with slight pain anteriorly upon flexion, abduction and external rotation, with a positive Neer's Impingement Sign, Hawkins' Impingement Sign, Jobe's, and concomitant Sulcus Sign. The patient also reported having "mild discomfort" in the shoulder at the time of this reassessment. Treatment was continued for an additional 4 weeks. A visual analog pain scale revealed 100%

Fig 2. *Patient 1: computed tomography. Three-dimensional reformatted CT images of the left glenohumeral region as viewed from the posterior (A) and left scapula (B) reveal a hypoplastic glenoid neck, curved undersurface of the acromion, and glenohumeral joint degenerative changes. A reformatted coronal image (C) also reveals a large osteophyte arising from the superior glenoid rim (arrow). Axial CT images (D, E) reveal the glenoid hypoplasia, retroversion of the glenoid cavity, posterior subluxation of the humeral head, and osteophytes arising from the posterior glenoid neck (arrow in D). Note the widening of the anterior portion of the glenohumeral joint best seen in (E).*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decrease in pain after the sixth overall week of treatment. With moderate patient compliance to performing prescribed exercises, treatment provided complete relief of symptoms associated with this acute exacerbation.

Discussion

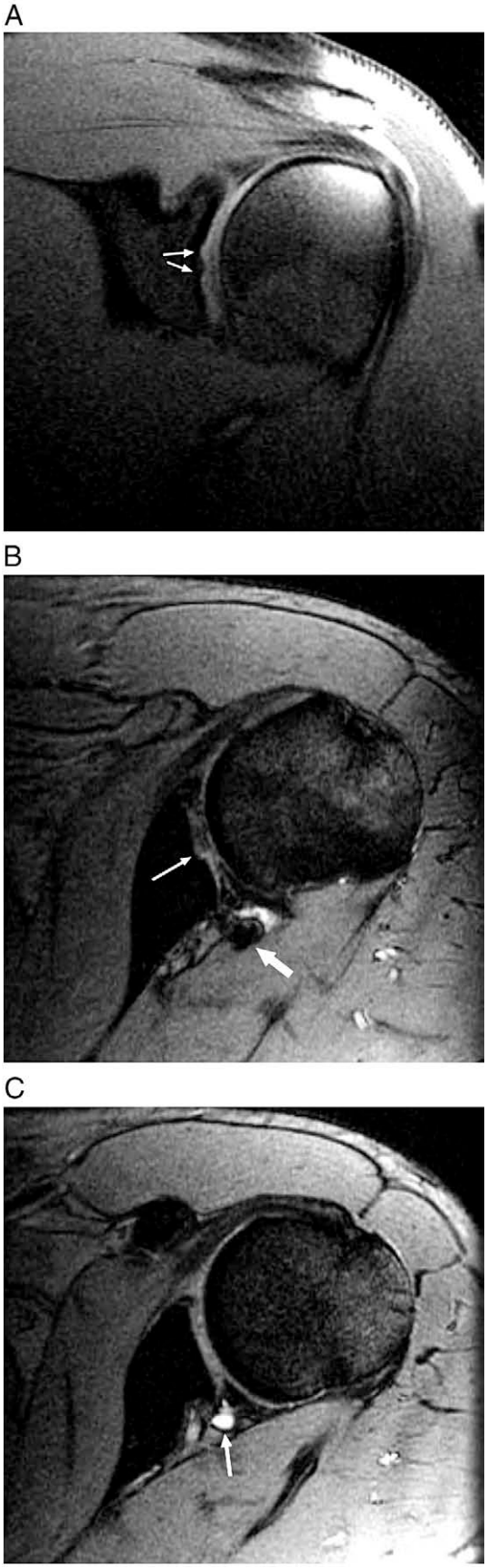
Glenoid hypoplasia is a developmental anomaly of the scapular neck characterized by an incongruent glenoid surface. This anomaly is often associated with changes in the articular cartilage and glenoid labrum as well as a spectrum of osseous changes. First described in 1931, there have been more than 100 cases reported in the literature to date.[1,2]

The pathogenesis of glenoid hypoplasia remains uncertain; however, genetic links, obstetrical trauma, infection, muscular dystrophy, maldevelopment of the glenoid ossification centers, and arthrogryposis have all been postulated as etiologic factors.[1,3] The glenoid contains 2 of at least 8 growth centers located in the scapula. An abnormality of one or both of the ossification centers within the glenoid, allowing a failure of the inferior glenoid precartilage to ossify, is implicated to be the most likely cause of glenoid hypoplasia. A recent MR imaging study demonstrated the presence of fibrocartilaginous tissue or fat tissue replacing the hypoplastic glenoid and scapular neck,[1,3,12] findings that suggest that aberration of growth centers is most likely not the only abnormality causing glenoid hypoplasia.[1]

The most frequent complication of glenoid hypoplasia is degenerative disease, which likely results from the incongruence of the glenoid articular surface.[5] The 2 cases presented here demonstrate these degenerative changes as well as instability, both of which were most likely exacerbated by traumatic activities. Both our patients reported a history of heavy weight lifting, particularly bench pressing, an activity that exerts significant shearing forces upon the glenohumeral joint. Previous studies suggest that a hypoplastic glenoid is more susceptible to injury from such forces considering the vulnerability of the hypertrophied posterior labrum.[2,12]

The conservative approach to glenoid hypoplasia consists of a physician-directed physical therapy program for rehabilitation and strengthening of the scapular stabilizers, rotator cuff, and deltoid muscles.[1,3] Further conservative care to address associated instability or internal joint derangement should be considered on a case-by-case basis. Surgical options for glenoid hypoplasia include scapular

Fig 3. *Patient 2: conventional radiographs of the right (A) and left (B) shoulders reveal marked hypoplasia of the glenoid necks bilaterally and an irregular, dentate or notched articular surface of the left glenoid rim (arrow in B). Both humeral heads are slightly hypoplastic. A Y-scapular view of the right shoulder (C) reveals a curved (type II) undersurface of the acromion (arrows).*



osteotomy, bone grafting, and soft tissue reconstruction in an attempt to restore the abnormal anatomy.[1,3] A total or hemiarthroplasty may be performed in more severe cases of secondary degeneration with unremitting symptoms.[13] Symptoms in both of our patients were managed successfully with conservative chiropractic care and rehabilitation.

In patient 1, a 7-week trial of mobilization of the glenohumeral joint, soft tissue techniques (ART and Nimmo), and proprioceptive stretching and strengthening of the rotator cuff musculature completely resolved the patient's symptoms. Of the soft tissue techniques used above, ART is a movement based technique that uses specific maneuvers purportedly aimed at the removal of adhesions and fibrosis, thereby restoring optimal texture, motion, and function of muscles, tendons, ligaments, fascia, and nerves.[14] These adhesions can occur as a result of acute injury, repetitive motion, and constant pressure or tension.[14] Nimmo technique is another soft tissue approach that uses the application of simple pressure to tender areas of a muscle in order to relieve localized muscle spasm.[1] In this case, full patient compliance with the stretching and strengthening protocols likely facilitated the rapid recovery.

The symptoms in patient 2 presented as an acute exacerbation of an injury that occurred four years earlier. Management included mobilization of the glenohumeral joint and acromioclavicular joint, as well as addressing the associated soft tissue dysfunction of the shoulder girdle with ART maneuvers. These methods were combined with home tubing exercises for the rotator cuff as well as shoulder isotonic internal and external rotation. Following treatment in this case over a 6-week time period, the patient reported complete relief of symptoms.

Both patients exhibited imaging findings consistent with glenoid hypoplasia. Furthermore, the imaging and orthopedic assessments in both cases are consistent with those described in the Theodorou et al[1] study. Both of our patients had cross-sectional MR imaging studies and 1 also had CT imaging that corroborated the orthopedic and conventional radiographic findings. Such advanced imaging, with or without arthrography, should be included in the evaluation of patients with symptoms that fail to improve over time.

Fig 4. *Patient 2: coronal oblique short tau inversion recovery (A) and transaxial gradient echocardiographic (B,C) images of the left shoulder. Note the hypoplastic glenoid cavities and the irregular notch-like (dentate) region in the central part of the cavity where the articular cartilage appears irregular (thin arrows in A & B). Similar changes were identified on MR images of the right shoulder (not shown). The transaxial images (B,C) show that the posterior glenoid labrum is more prominent than the anterior glenoid, is separated from the glenoid rim by a considerable distance and is associated with a large collection of low signal material representing either an osteophyte or an intraarticular osteocartilaginous body (thick arrow in B). A small cyst-like fluid intensity adjacent to the posterior glenoid labrum (arrow in C) most likely represents a ganglion cyst or synovial cyst, a finding that is often associated with labral derangement but that is inconclusive in this case.*

Conclusion

To our knowledge, there have been no reports of the chiropractic management of patients with hypoplastic glenoid. The management in these 2 patients was directed at alleviating the symptoms associated with soft tissue dysfunction. In both patients, stretching, strengthening, and soft tissue modalities applied specifically to the shoulder girdle stabilizers, including the rotator cuff, appeared beneficial.

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