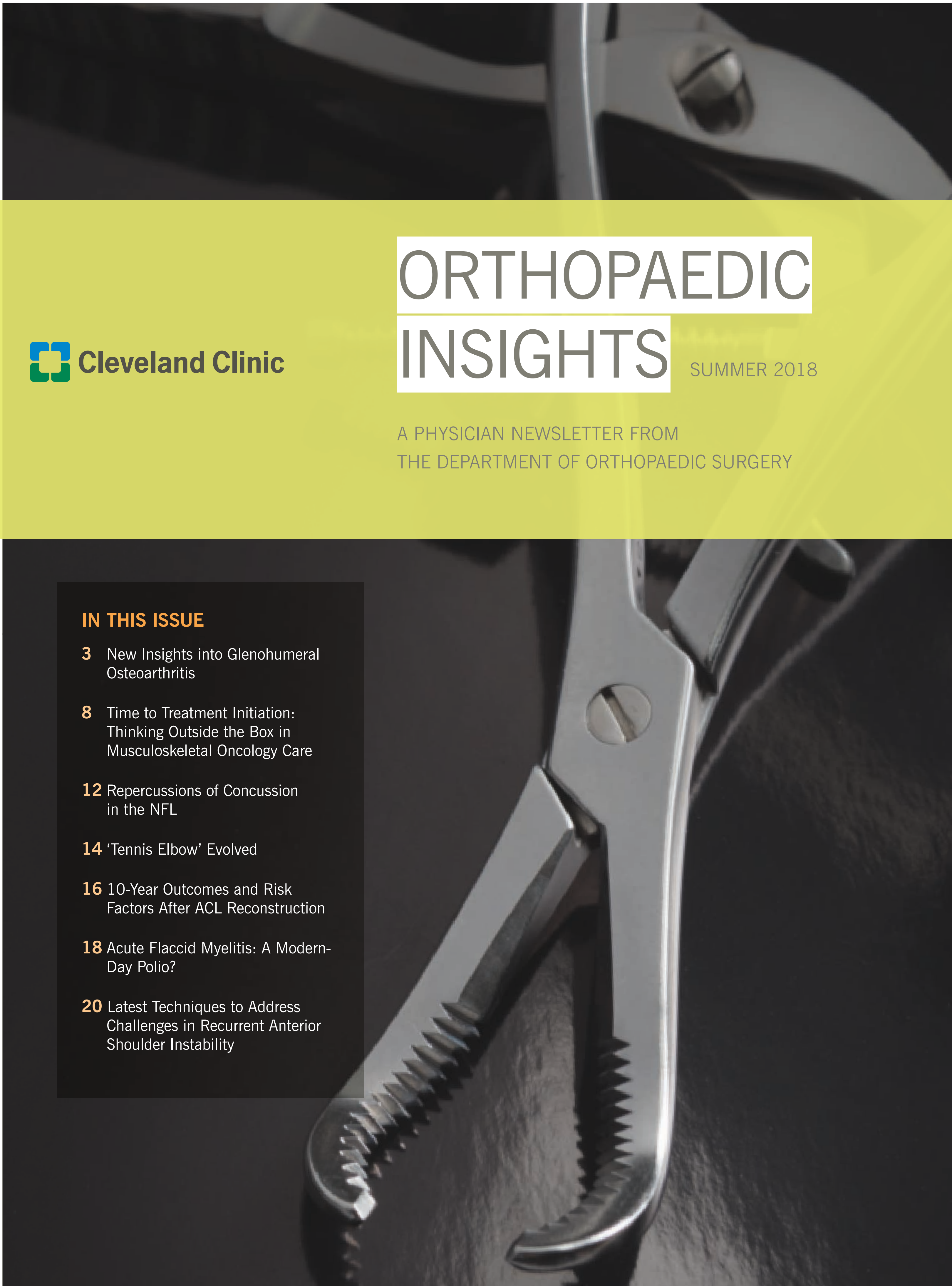


Cleveland Clinic

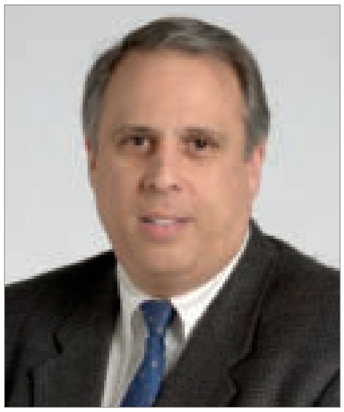
ORTHOPAEDIC INSIGHTS

SUMMER 2018

A PHYSICIAN NEWSLETTER FROM THE DEPARTMENT OF ORTHOPAEDIC SURGERY

IN THIS ISSUE

DEAR COLLEAGUES



The variety of activities that takes place in a large orthopaedic surgery practice such as ours is hard to match in any other specialty, and it creates excitement and challenge every single day.

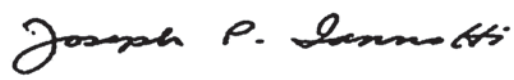
This issue of *Orthopaedic Insights* is a reflection of that variety. Articles in this issue touch on subjects ranging from cancer to tennis elbow to a rare pediatric disorder to ubiquitous osteoarthritis. We discuss surgeries ranging from complex nerve transfers to joint replacement. We also cover concussions in the National Football League, the success of ACL reconstruction, the latest techniques to address shoulder instability and more.

As diverse as our activities are, one theme runs through every effort and every single interaction we have: The patient comes first. Improving the health and quality of life for our patients is our overriding goal, and that will never change, no matter the pressures that we (and you) feel in today's practice of medicine.

Thank you for taking a few moments to review the articles contained herein. They represent a tremendous amount of work and dedication on the part of our staff and reflect just a few of the innovative clinical and research programs our talented team has undertaken.

We look forward to continued collaboration with you, our valued colleagues across the country and around the world.

Please feel free to contact me at any time.



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Cleveland Clinic's orthopaedics program is ranked No. 3 in the nation in *U.S. News & World Report*'s "Best Hospitals" survey — the top-ranked program in Ohio.

ORTHOPAEDIC INSIGHTS | SUMMER 2018

Orthopaedic Insights is published by Cleveland Clinic's Department of Orthopaedic Surgery to inform musculoskeletal specialists about advances in diagnosis, medical and surgical management, and research.

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THREE STUDIES PROVIDE USEFUL NEW INSIGHTS INTO GLENOHUMERAL OSTEOARTHRITIS

PATHOLOGIC WEAR PATTERNS, PROGRESSION OF PATHOLOGY, ROTATOR CUFF FATTY INFILTRATION EXAMINED

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We have recently conducted three studies to improve our understanding of pathologic wear patterns in glenohumeral osteoarthritis, including factors associated with certain pathologies. This article summarizes our results.

Study 1: Two new glenoid subtypes in the classification of glenohumeral osteoarthritis

The Walch classification system is the most commonly used method for defining pathology in glenohumeral osteoarthritis and impacts decision-making and outcomes in shoulder arthroplasty. Glenoids are classified (as subtypes A1, A2, B1, B2 and C) on the basis of the pattern of glenoid morphology and bone loss, and the presence of subluxation of the humeral head. However, there are pathologic patterns not easily classified within the original Walch system, particularly cases with more severe pathology.

We hypothesized that these patterns have important distinguishable anatomic characteristics that may have different implications for clinical outcome and recommended treatment.

The purpose of the study was to use 3D computed tomography (CT) image analysis to define additional pathologic subtypes that can be differentiated from the current Walch classification. We performed quantitative measurements of premorbid and pathologic anatomy using preoperative 3D CT scans from 155 cases of advanced glenohumeral osteoarthritis that underwent anatomic or reverse total shoulder arthroplasty. We defined premorbid glenohumeral anatomy on the basis of previously validated methods using 3D glenoid vault and humeral best-fit circle models including the premorbid glenoid version, joint-line medialization and humeral-glenoid alignment (Figure 1).

THESE NEW FINDINGS MAY ULTIMATELY IMPACT TREATMENT DECISION-MAKING FOR PATIENTS WITH END-STAGE GLENOHUMERAL OSTEOARTHRITIS.

We determined the anatomic features that differentiate new glenoid morphologic patterns from the existing Walch classification both qualitatively and quantitatively, and defined two new glenoid subtypes (B3 and C2) (Table 1). The B3 glenoid (Figure 2) has high retroversion, normal premorbid version and acquired central and posterior bone loss that, on average, is greater than that of the B2 glenoid.

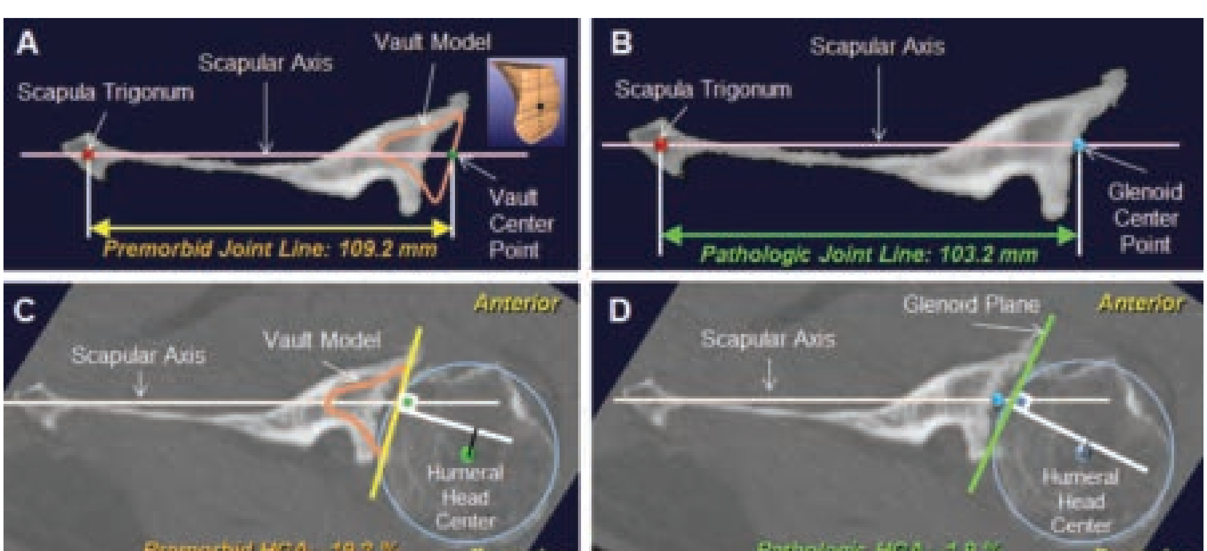

Figure 1

Case example of a B3 glenoid. The premorbid (A) and pathologic (B) joint line and premorbid (C) and pathologic (D) humeral-glenoid alignment (HGA) were measured on the 2D orthogonal axial image that passed through the glenoid center point. The position of the premorbid joint line was measured as the distance between the vault center point and the scapula trigonum (A). The position of the pathologic joint line was measured as the distance between the glenoid center point and the scapula trigonum (B). Premorbid HGA was measured as the distance (black line) from the humeral head center to the perpendicular line (white) drawn from the vault center point (C). Pathologic HGA was measured as the distance (black line) from the humeral head center to the perpendicular line (white) drawn from the glenoid center point (D).

TABLE 1. MEAN MEASUREMENTS BY WALCH SUBTYPE*								
	Walch Subtype (N)							
Measure	A1 (36)	A2 (22)	B1 (2)	B2 (56)	B3 (29)	C1 (3)	C2 (7)	*P* Value†
Pathologic glenoid version (°)	−6.6 ± 4.3	−8.7 ± 5.9	−10.6 ± 3.7	−20.2 ± 6.6	−22.6 ± 6.1	−23.4 ± 3.0	−28.5 ± 4.4	< 0.001
Premorbid glenoid version (°)	−5.1 ± 2.5	−5.3 ± 3.8	−6.5 ± 2.1	−8.3 ± 2.8	−7.0 ± 3.2	−19.0 ± 8.0	−19.4 ± 3.3	< 0.001
Paleo glenoid length (% of vault length)	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	44.0 ± 10.5	5.7 ± 10.5	0.0 ± 0.0	49.1 ± 10.6	< 0.001
Joint-line medialization (mm)	1.3 ± 1.2	4.7 ± 2.2	3.1 ± 0.1	2.1 ± 1.1	5.9 ± 2.4	3.6 ± 1.3	2.1 ± 2.1	< 0.001
Pathologic HGA (% of head diameter)	−2.3 ± 5.1	−1.0 ± 4.6	−9.9 ± 1.0	−7.3 ± 6.6	−3.5 ± 6.3	3.3 ± 6.0	−8.5 ± 7.5	< 0.001
Premorbid HGA (% of head diameter)	−5.3 ± 5.9	−6.9 ± 5.1	−15.4 ± 2.2	−18.5 ± 7.0	−18.7 ± 6.1	−2.2 ± 5.0	−16.8 ± 8.8	< 0.001

*Values are given as the mean and the standard deviation. †For a given measure, the *P* value represents a significant difference in the mean values across all of the glenoid subtypes in the modified classification system. Post hoc tests (with Bonferroni multiple-comparison corrections) were then conducted to identify specific glenoid subtypes showing differences on pairwise comparisons. HGA = humeral-glenoid alignment.

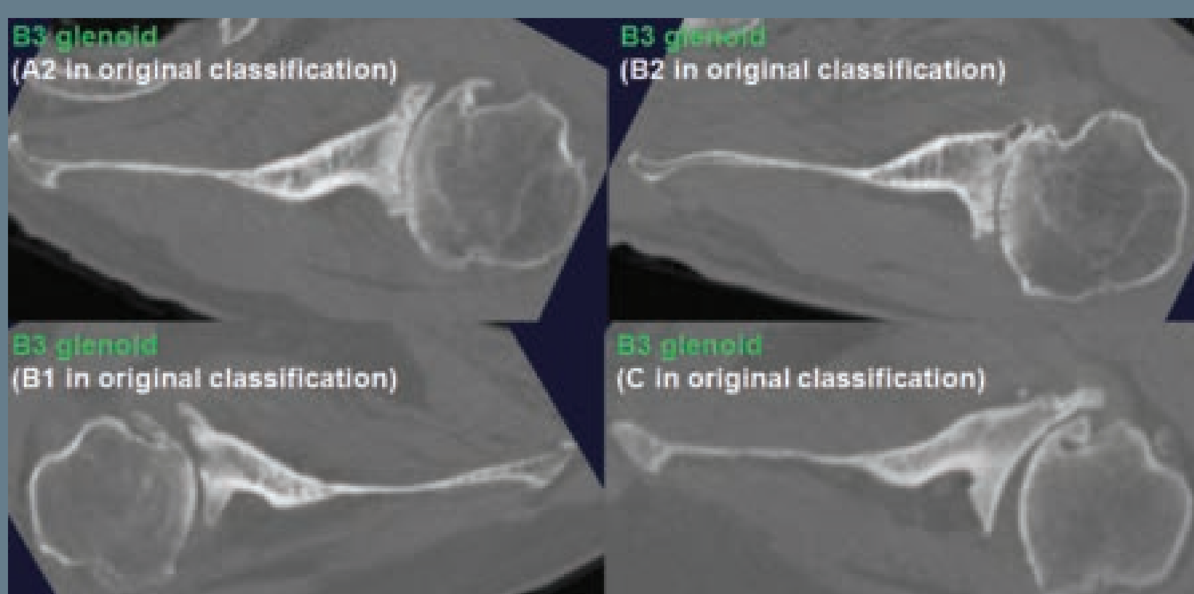

Figure 2. The B3 glenoid has both central and asymmetric posterior bone loss, making the joint line more medialized. Unlike the B2 glenoid, the B3 glenoid does not have a paleo glenoid, or it is so small that it is difficult to define when present, due to bone loss. Shown are four examples of B3 glenoids, with the classification according to the original Walch classification system also noted.

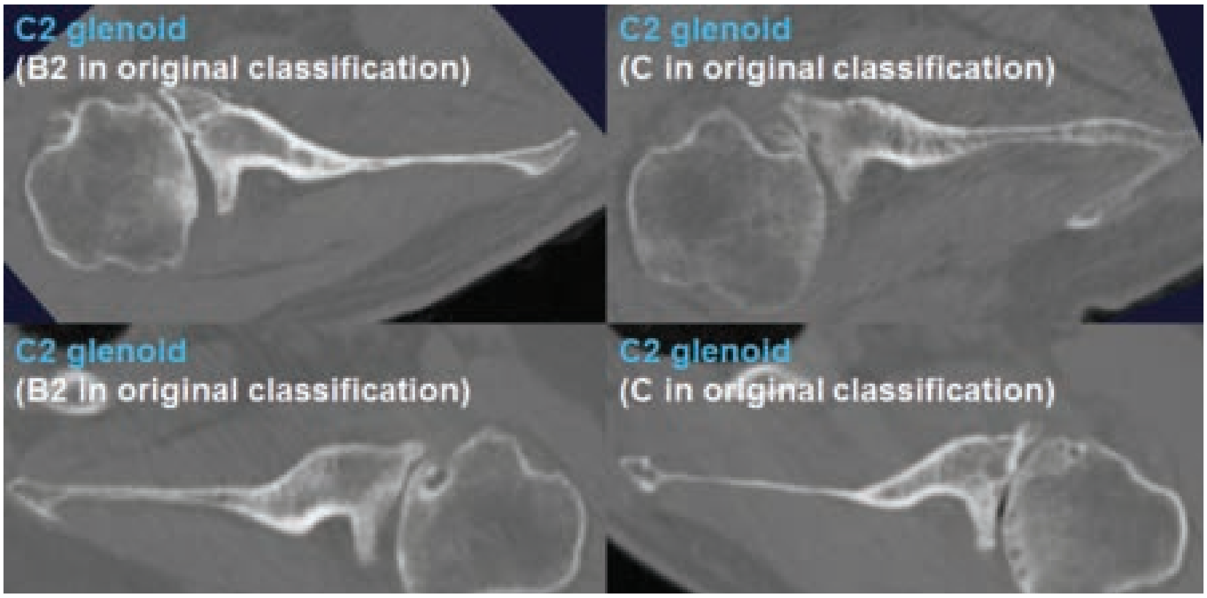

Figure 3. The C2 glenoid is similar to the B2 glenoid in that there is a biconcave surface with associated posterior humeral head subluxation; however, the pathologic glenoid retroversion and the premorbid glenoid version are both greater in the C2 compared with the B2 glenoid. Shown are four examples of C2 glenoids, with the classification according to the original Walch classification system also noted.

The C2 glenoid (Figure 3) is dysplastic with high retroversion, high premorbid version and acquired posterior bone loss, giving it the appearance of a biconcave glenoid with posterior translation of the humeral head. This C2 glenoid can be confused with the B2 glenoid. The new B3 and C2 glenoid subtypes may result in different clinical outcomes than classic B2 or C types; therefore, our findings suggest that they should be included in a modified classification system.

Study 2: Progression of glenoid morphology in glenohumeral osteoarthritis

While the addition of new Walch subtypes allows for better distinction of more severe pathologic patterns, the progression of glenohumeral osteoarthritis over time and the factors that contribute to progression are still not well-defined. We performed a follow-up study with 3D CT image analysis to determine whether there are common patterns of pathologic progression based on Walch classification and whether glenoid bone-loss patterns correlate with rotator cuff fatty infiltration.

Sixty-five cases of glenohumeral osteoarthritis (42 A-type glenoids, 23 B-type glenoids) with at least two shoulder CT scans performed at least 24 months apart were identified. The amount and location of glenoid bone loss was again measured (Figure 1), and rotator cuff fatty infiltration was calculated as a percentage of cross-sectional muscle area.

At an average of 74 ± 32 months after the initial CT scans, only eight out of 42 A1 glenoids had evidence of pathologic progression (five to A2 type, three to B type), whereas 17 of 19 B1 glenoids had progressed (15 to B2, two to B3). This difference was significant on

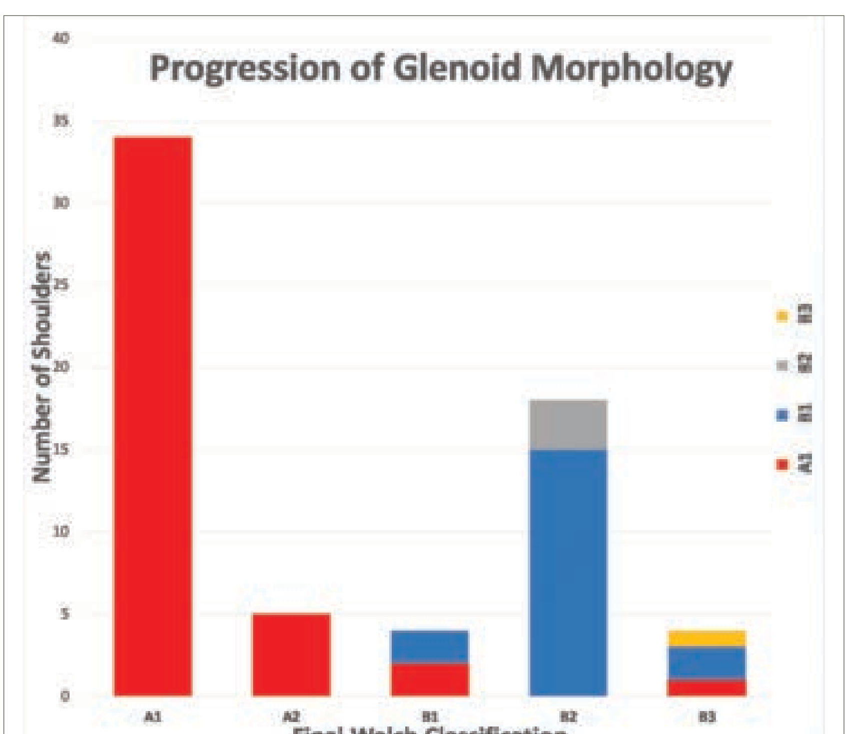

Figure 4

Bar graph representing the progression of glenoid morphology according to the modified Walch type. The height of each column represents the total number of shoulders of each Walch type on the last available CT scan, whereas the colors of each bar illustrate the initial Walch classification(s) according to the legend along the right side of the figure.

univariate and multivariate analysis ($P < 0.001$) (Figure 4). The odds of joint-line medialization occurring were 8.1 times higher (95 percent confidence interval [CI]: 2.1-31.4) for B-type glenoids than for A-type glenoids. Among the glenoids that underwent medialization, B-type glenoids showed more medialization over time (estimated mm/year; $P = 0.036$), whereas no significant relationship between medialization and time was observed for A-type glenoids (estimated change, 0.013 mm/year; $P = 0.95$) (Figure 5).

The median percentage of fatty infiltration in the infraspinatus muscle was higher in associaion with B-type glenoids than with A-type glenoids on both initial (14 percent versus 7 percent; $P < 0.001$) and final follow-up (16 percent versus 10 percent; $P = 0.003$) CT scans.

These findings demonstrate that asymmetric bone loss rarely develops in A1 glenoids, whereas initial posterior translation of the humeral head (B1 glenoids) may be associated with subsequent development and progression of posterior glenoid bone loss over time. While differences in fatty infiltration of the posterior rotator cuff were seen between A-type and B-type glenoids, the clinical relevance of this finding is currently unknown.

Study 3: Association between rotator cuff fatty infiltration and glenoid morphology in glenohumeral osteoarthritis

The association of rotator cuff fatty infiltration and preoperative glenoid morphology as defined by the modified Walch classification was investigated further in another follow-up study. We performed preoperative 3D CT image analysis in 190 cases of advanced glenohumeral osteoarthritis that underwent anatomic or reverse total shoulder arthroplasty (Figure 1). Rotator cuff fatty infiltration was assessed by the Goutallier classification on the sagittal CT slice just medial to the spinoglenoid notch for each muscle.

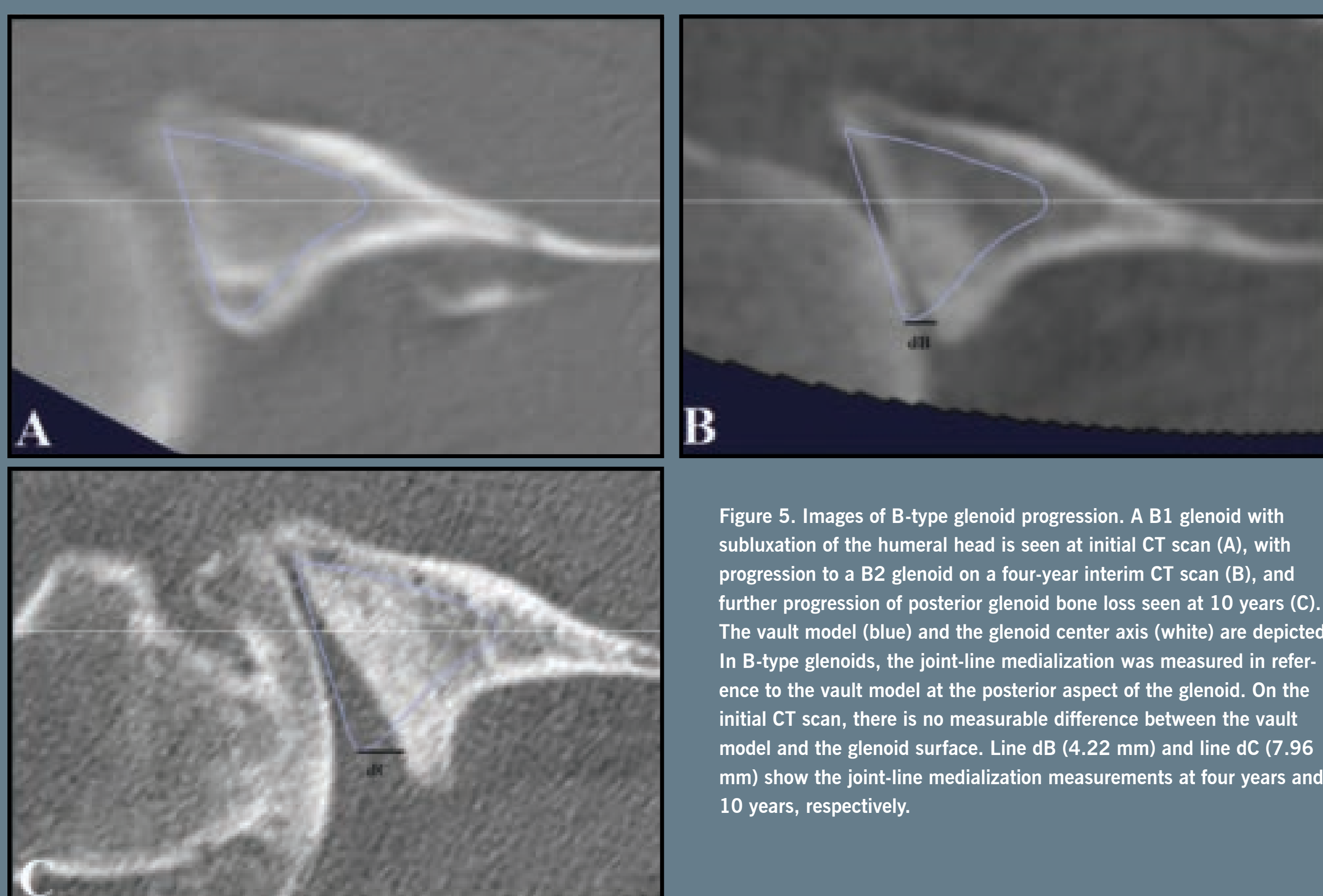

Figure 5. Images of B-type glenoid progression. A B1 glenoid with subluxation of the humeral head is seen at initial CT scan (A), with progression to a B2 glenoid on a four-year interim CT scan (B), and further progression of posterior glenoid bone loss seen at 10 years (C). The vault model (blue) and the glenoid center axis (white) are depicted. In B-type glenoids, the joint-line medialization was measured in reference to the vault model at the posterior aspect of the glenoid. On the initial CT scan, there is no measurable difference between the vault model and the glenoid surface. Line dB (4.22 mm) and line dC (7.96 mm) show the joint-line medialization measurements at four years and 10 years, respectively.

There was a significant difference in Goutallier score for the supraspinatus, infraspinatus and teres minor muscles between Walch subtypes (A1, A2, B1, B2, B3, C1, C2) ($P \leq 0.05$). High-grade posterior rotator cuff fatty infiltration was present in 55 percent (21 out of 38 cases) of B3 glenoids compared with 8 percent (three of 39) of A1 glenoids (Table 2). Increasing joint-line medialization was associated with increasing fatty infiltration of all rotator cuff muscles ($P \leq 0.05$). Higher fatty infiltration of the infraspinatus, teres minor and combined posterior rotator cuff muscles was associated with increasing glenoid retroversion ($P \leq 0.05$). After controlling for joint-line medialization and retroversion, B3 glenoids were more likely to have fatty infiltration of the supraspinatus and infraspinatus muscles than were B2 glenoids.

This study further defines associations between rotator cuff muscle changes and glenoid wear in glenohumeral osteoarthritis. Further studies are needed to determine causal relationships between these changes and pathologic progression over time.

Impact on clinical practice

The results of these three studies further define the common bony wear patterns in glenohumeral arthritis, the progression of wear over time and its association with rotator cuff muscle fatty infiltration. These new findings may ultimately impact treatment decision-making with regard to the timing of surgical intervention and the type of shoulder arthroplasty (anatomic versus reverse replacement) undertaken in patients with end-stage glenohumeral osteoarthritis who fail nonoperative management, in order to maximize clinical outcome and implant longevity.

TABLE 2. LOW- AND HIGH-GRADE ROTATOR CUFF MUSCLE FATTY INFILTRATION (FI) BY WALCH SUBTYPE*

Walch Subtype (N)	Low- and High-Grade FI				High-Grade Posterior Cuff FI ($P < 0.0001$)
	Subscapularis ($P = 0.12$)	Supraspinatus ($P < 0.0001$)	Infraspinatus ($P < 0.0001$)	Teres Minor ($P = 0.011$)	
A1 (39)	2 (5%)	14 (36%)	7 (18%)	4 (10%)	3 (8%)
A2 (24)	5 (21%)	18 (75%)	12 (50%)	4 (17%)	3 (12%)
B2 (75)	4 (5%)	33 (44%)	35 (47%)	12 (16%)	12 (16%)
B3 (38)	4 (11%)	31 (82%)	32 (84%)	15 (39%)	21 (55%)

*Differences in the distribution of low- and high-grade FI of each rotator cuff muscle among the modified Walch types were assessed. No FI was classified as a Goutallier score of 0 or 1. Low- and high-grade FI included Goutallier scores of ≥ 2. High-grade posterior cuff FI (the sum of the scores for the infraspinatus and teres minor) was a Goutallier score of ≥ 4, and low-grade posterior cuff FI was a score of < 4. A P value of ≤ 0.05 indicates significance.

Dr. Ricchetti is Center Director for Shoulder Surgery in the Department of Orthopaedic Surgery. Dr. Iannotti is Acting Chairman, Department of Orthopaedic Surgery, and Chairman, Orthopaedic & Rheumatologic Institute.

References

Iannotti JP, Jun BJ, Patterson TE, Ricchetti ET. Quantitative measurement of bony pathology in advanced glenohumeral osteoarthritis. J Bone Joint Surg Am. *2017;99(17):1460-1468.*

Walker KE, Simcock XC, Jun BJ, Iannotti JP, Ricchetti ET. Progression of glenoid morphology in glenohumeral osteoarthritis. J Bone Joint Surg Am. *2018;100(1):49-56.*

Donohue KW, Ricchetti ET, Ho JC, Iannotti JP. The association between rotator cuff muscle fatty infiltration and glenoid morphology in glenohumeral osteoarthritis. J Bone Joint Surg Am. *2018;100(5):381-387.*

THINKING OUTSIDE THE BOX — NEW IDEAS THAT PRIORITIZE TIME TO TREATMENT

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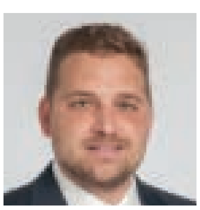

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PUSHING THE ENVELOPE IN MUSCULOSKELETAL ONCOLOGY CARE

The words "tumor," "lesion" and "mass" all elicit a flood of emotions for patients receiving a new diagnosis. Though the vast majority of new bone and soft tissue lesions are benign, having an abnormal finding is nerve-racking for patients. As a patient-focused Musculoskeletal Tumor Center, we have made reducing this anxiety a top priority through protocols that expedite time-to-treatment initiation (TTI). We define TTI as time from diagnosis to treatment.

In this article, we review techniques and processes that are decreasing our TTI in meaningful ways — and improving patient care (Table 1).

Clinical evaluation in a single visit

Coordinated care visits and multidisciplinary clinic model. Multiple physicians are involved in treating patients with bone or soft tissue sarcoma, metastatic disease involving the musculoskeletal system and certain aggressive benign tumors. Our goal is for patients to have all pertinent initial appointments completed in a single visit, which also gives us the ability to begin planning for treatment the same day a diagnosis is made.

A multidisciplinary clinic model trims excess time — sometimes by days or weeks — that would otherwise delay the start of treatment.

Preliminary diagnoses within minutes

Fine needle aspiration combined with core needle biopsy. Combining core needle biopsy and fine needle aspiration (FNA) as part of the initial office-based biopsy protocol may help reduce TTI.

While core needle biopsy has the advantage of obtaining a large amount of tissue for diagnostic purposes, it can take three to five days for final diagnosis to be reported due to tissue processing requirements. Instead, we employ FNA along with a core needle biopsy in the office setting for masses that are palpable and do not require image targeting (Figure 1).

TABLE 1. REDUCING TIME TO TREATMENT INITIATION (TTI)

PARADIGM TO DECREASE TTI	ADVANTAGES
Coordinated appointments	Multiple physicians are seen during a single visit/appointment, improving communication between treating doctors, decreasing patient travel, and smoothing transitions of care and surveillance in the treatment process.
Fine needle aspiration biopsy	Biopsy of soft tissue lesion in the office permits immediate diagnosis and faster formation of action plan of care.
Hypofractionated radiation dosing	Permits faster removal of soft tissue sarcoma compared with conventional preoperative radiation protocols, with equivalent oncologic outcomes.
Brachytherapy	Used synergistically or definitively. Can help limit toxicity to adjacent tissues/joints. Provides faster removal of tumor without need for preoperative external beam radiation therapy (EBRT). Limits need for patient travel. Permits easier coordination between multiple surgical services.

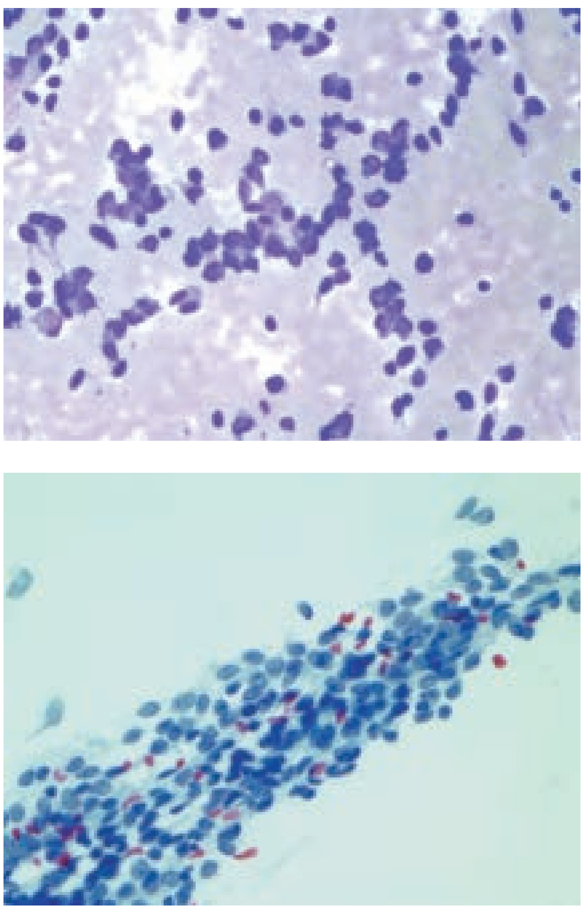


Figure 1. Fine needle aspirate of synovial sarcoma on air-dried Diff-Quik® stain (top) for immediate interpretation, and Papanicolaou alcohol-fixed smears for later review (bottom).

Radiation protocol: Five weeks condensed to five days

Hypofractionated preoperative radiation. Surgery in combination with radiation decreases risk for local recurrence of soft tissue sarcomas. Traditionally, preoperative radiation therapy takes place over the course of five weeks, with an additional three to six weeks of rest for radiation skin effects to heal prior to surgery. In other words, a patient could wait two to three months between diagnosis and surgery.

Cleveland Clinic uses a new protocol that reduces this time period significantly. Hypofractionated preoperative radiation condenses the traditional five weeks of radiation into five days with biologically equivalent results. In addition, rather than following the traditional three- to six-week rest period, we now remove the sarcoma definitively within 12 to 72 hours after radiation ends.

Recent studies demonstrate that hypofractionated preoperative radiation yields similar local recurrence rates and lowers early and late complications compared with traditional radiation dosing.

AS A PATIENT-FOCUSED MUSCULOSKELETAL TUMOR CENTER, WE HAVE MADE REDUCING THIS ANXIETY A TOP PRIORITY.

Many patients travel significant distances to our tertiary sarcoma center for treatment. This new radiation therapy approach makes treatment much more convenient for all patients and allows us to continue providing gold-standard treatment for this rare cancer.

Brachytherapy (interstitial catheter-based radiation). Brachytherapy, used either with traditional external beam radiation therapy (EBRT) or as definitive treatment, continues to be of great value in selected soft tissue sarcoma cases.

Synergistic effects with EBRT. Traditional beam radiation can be toxic to adjacent organs, tissue and bones/joints. Brachytherapy, on the other hand, can limit the overall dose of radiation to adjacent tissue without sacrificing dose to the tumor bed. We often deliver a low preoperative dose of EBRT to areas where toxicity from radiation can lead to potentially difficult long-term sequelae (joint stiffness, mucosal surface irritation, wound healing difficulties, etc.).

Sarcoma surgeons resect the tumor, then implant brachytherapy catheters. Postoperatively, additional radiation can be delivered in an even more localized fashion through the catheters, limiting toxic level dosing to adjacent tissues.

Brachytherapy as definitive treatment. By utilizing brachytherapy as definitive treatment, we can forgo preoperative radiation and instead remove the tumor shortly after diagnosis. Catheters are implanted at the time of surgery, and radiation is completed while the patient is in the hospital. The patient returns to the operating room for catheter removal and final soft tissue reconstruction, usually within five to 10 days.

In addition to earlier tumor resection, this technique obviates the need for patients to return daily for radiation therapy.

Furthermore, use of brachytherapy can simplify wound reconstruction in combination with plastic surgery. Reconstruction is scheduled at the completion of brachytherapy, when surgical margins are confirmed and the plastic surgeon has prepared for the known soft tissue defect and planned reconstructive options.

WE ARE COMMITTED TO ADAPTING OUR PRACTICES TO MELD EVIDENCE-BASED MEDICINE AND PATIENT NEEDS TO PRODUCE THE BEST POSSIBLE ONCOLOGIC AND FUNCTIONAL OUTCOMES.

Our No. 1 focus is the patient

Whether meeting for the first time a patient who has new radiographic or clinical exam findings, seeing patients for their five-year follow-up visit, providing a second opinion consultation, or walking a patient with an active cancer diagnosis through a difficult journey, we recognize the opportunity to build relationships with our patients and create a powerful treatment team. We are committed to adapting our practices to meld evidence-based medicine and patient needs to produce the best possible oncologic and functional outcomes.

Drs. Mesko and Nystrom are orthopaedic oncologists, and Dr. Mesko directs the Musculoskeletal Tumor Center. Dr. Scott, Department of Radiation Oncology, specializes in sarcoma radiation. His laboratory focuses on Ewing's sarcoma and cancer evolution using mathematical modeling, data science and experimental evolution. Dr. Kilpatrick, Department of Pathology, has special interest in bone and soft tissue tumors. Ms. Maggiotto is Sarcoma Program Manager.

Reference

Koseła-Paterczyk H, Szacht M, Morysiński T, et al. Pre-operative hypofractionated radiotherapy in the treatment of localized soft tissue sarcomas. Eur J Surg Oncol. *2014 Dec;40(12):1641-1647.*

Figure 1

A 53-year-old male with poorly controlled blood sugar presented with a one-month history of an enlarging thigh mass, biopsy proven as a high-grade myxofibrosarcoma involving the sartorius muscle. One week after diagnosis, we performed a wide en bloc excision. Immediately after excision, brachycatheters were placed in the wound 1 cm apart to cover the entire resection bed. White foam was placed over the femoral vessels and nerve structures, which were protected from the tumor by the adjacent resected sartorius muscle.

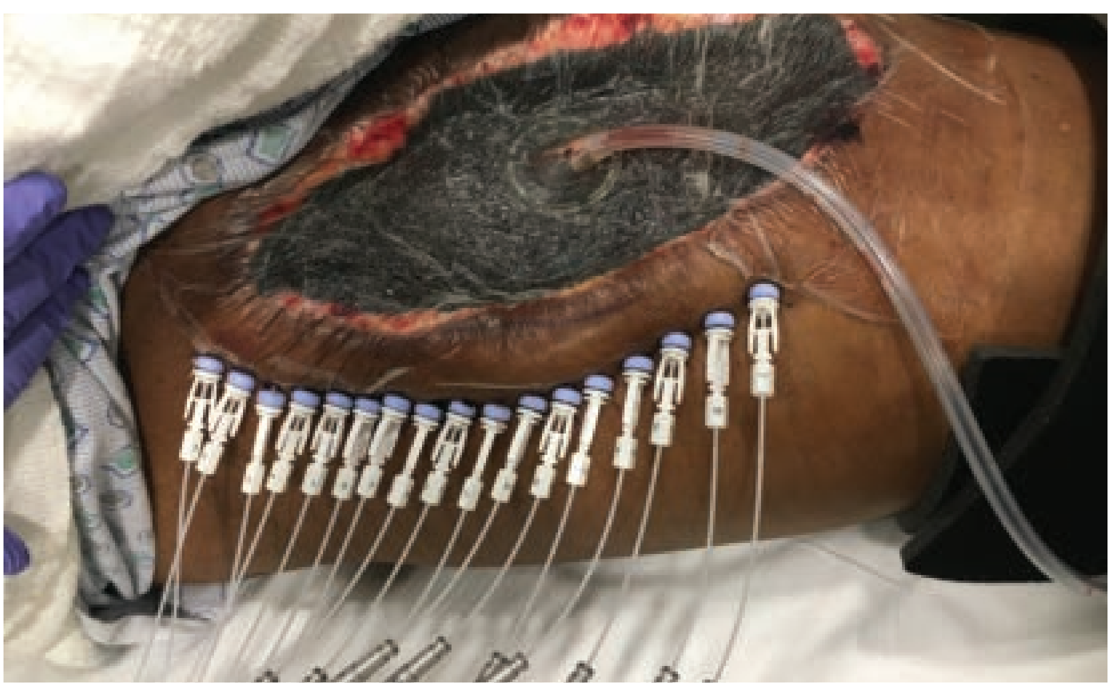
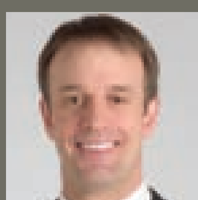


Figure 2

Once the catheters were placed and anchored to the tissue, a negative pressure device utilizing black foam was placed to cover the catheters. The patient then underwent five days (nine fractions, 38 Gy) of radiation treatments while admitted to the hospital. He underwent definitive plastic surgery reconstruction one week after the en bloc excision, once margins were determined clean. Brachytherapy was considered definitive treatment in this case.

CONCUSSION IN THE NFL: NEW STUDY DEMONSTRATES SIGNIFICANT DETRIMENTAL EFFECTS IN THE SHORT TERM

CAREER LONGEVITY, FINANCES, PERFORMANCE ALL NEGATIVELY AFFECTED



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The National Football League (NFL) recently released its injury data, which showed a disturbing increase in the number of diagnosed concussions. They were up 16 percent. In 2016, 243 concussions were reported; in 2017, 281 were reported.

This concerning statistic emerges as more articles are published in the medical literature and the lay press discussing the plausible link between traumatic brain injury, higher rates of depression and dementia among retired NFL players, and the postmortem diagnosis of chronic traumatic encephalopathy (CTE).

Studies have focused primarily on potential long-term deleterious effects of concussions during "life after football." Few if any researchers have looked at potential short-term effects on team and career length, financial consequences, and performance.

The average NFL career lasts only 3.3 years. To put that into perspective, most of us would not have finished medical school by the time we were "forced" to retire from the NFL.

With this information in mind, we decided to conduct this first-ever study examining short-term consequences of concussion. Our results were published in the *Orthopedic Journal of Sports Medicine*.

Concussed versus nonconcussed players

Filtering through publicly available data on nearly 6,000 players from 2005 to 2016, we identified 307 players who had sustained a concussion, based on NFL injury reports. A retrospective comparison was then made between the concussed and nonconcussed groups.

The results

When it comes to the short-term impact of concussions on NFL players, all four parameters evaluated revealed negative consequences of their injury. The four parameters we studied:

- Franchise release rate (retired, traded or cut)
- Career length
- Salary
- Performance

Franchise release rate

Those players concussed experienced a higher rate of roster instability after sustaining their concussion. After one year, the total release rate was 33.6 percent for the concussed group and 21.6 percent for the nonconcussed group. Looking at the three-year total release rate, 67.1 percent of the concussed group were released compared with 43.0 percent of the nonconcussed group.

Career length

We then evaluated longevity in the league overall, in terms of one-, three- and five-year survivorship. The probability of remaining in the NFL at one year after a concussion versus without concussion was 77.7 percent versus 78.3 percent. However, after three years, the figures changed to 30.1 percent versus 54.3 percent. And after five years, just 11.6 percent of concussed players were still in the NFL versus 36.6 percent of nonconcussed players (Figure 1).

IN THIS RETROSPECTIVE STUDY, CONCUSSED PLAYERS COMPARED WITH NONCONCUSSED PLAYERS SHOWED A VARIETY OF SHORT-TERM DETRIMENTAL EFFECTS.

Overall, 70 percent of those who were concussed were no longer in the NFL three years after their concussion, and 88 percent were not playing five years after their concussion.

Contract value

Having a concussion also affected the year-over-year change in contract value for the concussion group, with an overall salary reduction of $300,000 per year. This parallels another retrospective study that reported an anterior cruciate ligament tear costing an NFL player $500,000 per year after injury.

The largest salary declines in our concussion study were in the veteran groups, who generally command a higher salary. There was a mean decline of $460,000 per year for those concussed during their fifth through seventh years, and $1 million per year for those concussed during their seventh to tenth years.

Performance

Performance is more difficult to measure, given the lack of statistics for defensive players. Looking at tight ends, running backs, wide receivers and quarterbacks, we found an overall statistically significant decline in performance after a concussion.

Conclusion: Concussion hurts

In our retrospective study of the short-term effects of concussion in the NFL, concussed players compared with nonconcussed players showed a higher release rate and a lower probability of remaining in the NFL. In addition, the concussed athletes incurred a significant reduction in yearly salary, and at certain offensive positions, performed worse.

Concussion prevention, diagnosis and follow-up need to be addressed at all levels of sports. Results of our study may provide useful counseling information, and also demonstrate that player issues that impact athletes after concussion warrant additional attention from sports researchers as well as from NFL owners, personnel, coaches and those most affected — the players themselves. Subsequent studies will seek to establish the relationship between time missed due to concussion and the short-term parameters assessed in this study.

Dr. Figler is Interim Director, Primary Care Sports and Exercise Medicine; Director, Primary Care Sports and Exercise Medicine Fellowship; and Medical Director, Cleveland Clinic Concussion Center. Dr. Ramkumar is an orthopaedic surgical resident. *The authors thank students at Baylor College of Medicine for their assistance with this study.*

Reference

Navarro SM, Sokunbi OF, Haeberle HS, Schickendantz MS, Mont MA, Figler RA, Ramkumar PN. Short-term outcomes following concussion in the NFL: a study of player longevity, performance, and financial loss. Orthop J Sports Med. *2017 Nov 27;5(11). Published online.*

Figure 1

Kaplan-Meier survival curves for National Football League (NFL) players: concussive versus nonconcussive.

‘TENNIS ELBOW’ EVOLVED

A NEW CLASSIFICATION SYSTEM PROPOSED FOR COMMON EXTENSOR TENDINOPATHY

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Terms like “tennis elbow,” “lateral epicondylitis” and “chronic elbow tendinitis” have historically been used interchangeably in research publications and by healthcare providers to describe nonruptured pathology of the common extensor tendon of the elbow. However, these terms do not always characterize or reflect the true underlying intratendinous pathology.

Some patients clinically present with an acute “inflammatory” tendinopathy, some with a chronic “degenerative” tendinopathy and others as a mix of these presentations. While it is generally accepted that tendinopathy develops due to overloading of tensile and compressive forces of the tendon over time, the natural progression of tendinopathy is not well-understood.

As with any disease entity, the ability to choose appropriate treatment relies on an accurate diagnosis. Today, therapies for common extensor tendinopathy are wide-ranging and include physical therapy, instrument-assisted manual therapy, counterforce bracing, corticosteroid injections and, more recently, platelet-rich plasma (PRP) injections, bone marrow and adipose-derived stem cell injections, placental-derived extracellular matrix injections, and ultrasound-guided percutaneous tenotomy procedures.

A RELIABLE CLASSIFICATION SYSTEM FOR COMMON EXTENSOR TENDINOPATHY IS A NECESSITY.

Rationale for a new classification system

Our team members have conducted research that demonstrates significant variability in outcomes of common extensor tendinopathy therapies, specifically orthobiologics. Our hypothesis is that this treatment outcome variability exists because of the variability in tendon pathologies. While musculoskeletal ultrasound (MSK-US) has given us a reliable tool to outline different tendinopathy features, there has not been a widely accepted classification system that organizes these findings.

To accurately compare outcomes of tendon therapies, we first need to know that we are treating the same pathologic stage of tendinopathy. A reliable classification system for common extensor tendinopathy is a necessity.

Musculoskeletal ultrasound findings

MSK-US research on different pathologic features of common extensor tendinopathy has yielded these definitions:

- **Hyperemia.** Increased color power Doppler signal within the tendon.
- **Tendinosis.** A regional area of hypoechogenicity (darker echogenic signal) altering the normal fibrillar pattern of the tendon.
- **Intratendinous calcifications.** Small hyperechoic foci within the tendon that are not contiguous with the cortex of the enthesis.
- **Longitudinal tearing.** Longitudinal anechoic (completely absent echogenic signal) disruption of the fibrillary tendon architecture, along the length of the tendon.

New classification system

We constructed a new classification system based on the MSK-US identified features (above), and organized them into four distinct pathologic grades (Figure 1).

- Grade 1: Inflammatory tendinopathy.
- Grade 2: Degenerative tendinopathy.
- Grade 3: Inflammatory on degenerative tendinopathy.
- Grade 4: Longitudinal tearing.

We have also worked with the OrthoMiDaS Episode of Care (OME) team in our department to develop an OME Tendinopathy Module for our electronic medical record. The module will feature this classification system for common extensor tendinopathies.

This integration will allow us to establish a prospective cohort and longitudinally track the outcomes of our office-based injections and procedures on various grades of common extensor tendinopathy.

While this classification system may serve as a step toward more reliable and accurate tendinopathy research, rigorous reliability and prospective studies will ultimately determine its clinical usefulness to help guide tendinopathy treatment. If successful, this classification could be used as a research standard for all common extensor tendinopathy treatments, including physical rehabilitation and therapy, bracing, orthobiologic injections, and any minimally invasive office-based common extensor tendinopathy procedure. We have a great deal of work ahead of us, and we welcome your candid feedback regarding this new classification system.

Drs. King and Genin, sports medicine and medical orthopaedic physicians, are on staff in the Sports Health Center and Joint Preservation Center.

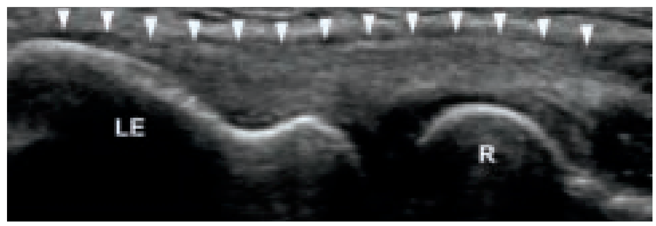
Reference

Chahla J, Cinque ME, Piuzzi NS, et al. A call for standardization in platelet-rich plasma preparation protocols and composition reporting: a systematic review of the clinical orthopaedic literature. J Bone Joint Surg Am. *2017 Oct 18;99(20):1769-1779.*

FIGURE 1. PROPOSED COMMON EXTENSOR TENDINOPATHY CLASSIFICATION SYSTEM

Normal common extensor tendon morphology

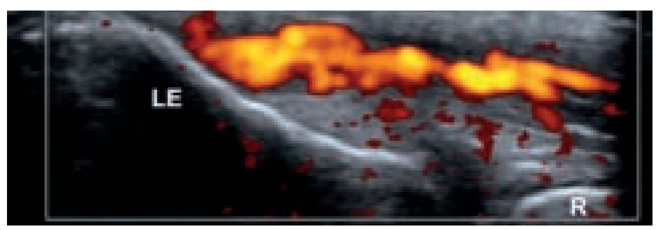
- Negative hyperemia
- Negative degenerative features of tendinosis
- Negative longitudinal tearing



Lateral epicondyle (LE), radial head (R), common extensor tendon (arrowheads).

Grade 1: Inflammatory tendinopathy

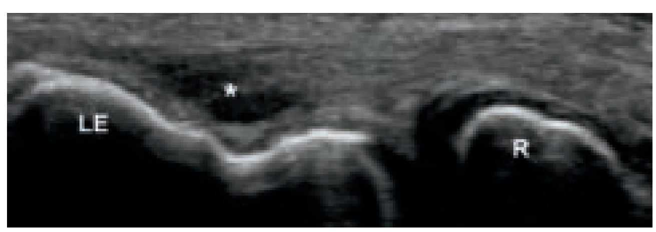
- Positive hyperemia
- Negative degenerative features of tendinosis
- Negative longitudinal tearing



Lateral epicondyle (LE), radial head (R), hyperemia (red-yellow area).

Grade 2: Degenerative tendinopathy

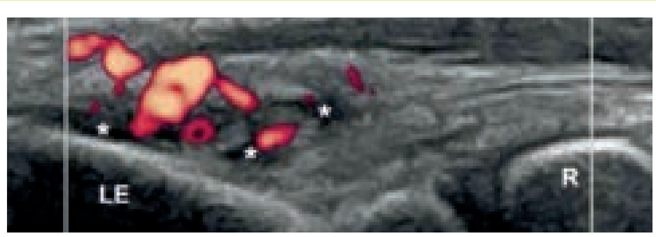
- Negative hyperemia
- Positive degenerative features of tendinosis
- Negative longitudinal tearing



Lateral epicondyle (LE), radial head (R), tendinosis (asterisk).

Grade 3: Inflammatory on degenerative tendinopathy

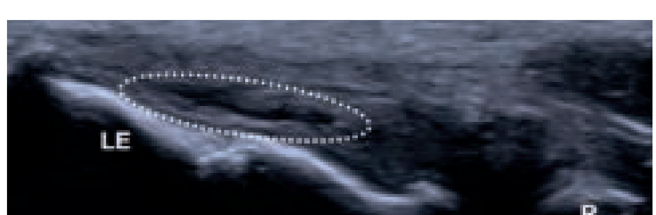
- Positive hyperemia
- Positive degenerative features of tendinosis
- Negative longitudinal tearing



Lateral epicondyle (LE), radial head (R), tendinosis (asterisks), hyperemia (red-orange area).

Grade 4: Longitudinal tearing

- Any degree of intrasubstance longitudinal tearing, regardless of the presence of hyperemia or tendinosis



Lateral epicondyle (LE), radial head (R), longitudinal tear (inside dotted ellipse).

10-YEAR OUTCOMES AND RISK FACTORS AFTER ACL RECONSTRUCTION: A MOON LONGITUDINAL PROSPECTIVE COHORT STUDY

PATIENTS CAN EXPECT TO STAY ACTIVE AND ENJOY HIGH SPORTS FUNCTION AND QUALITY OF LIFE

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A study we recently published shows quality of life and sports-related function was sustained for many patients 10 years out from anterior cruciate ligament (ACL) repair.

Our Multicenter Orthopaedics Outcome Network (MOON) group researchers demonstrated that patients could perform sports-related functions and maintain a high knee-related quality of life a decade after surgery, though activity levels did decline over time.

Our data show significant improvements in patient-reported outcome measures (sports function and quality of life) two years after surgery that were maintained at six and 10 years. These improvements were noted across a substantial population of 1,320 patients who made up 83 percent of our original study group.

A large cohort

A total of 1,597 patients with unilateral ACL reconstructions were identified and enrolled in the trial between 2002 and 2004 from seven sites in the MOON group, including Cleveland Clinic. Of those treated, 90 percent underwent a primary ACL reconstruction and 10 percent a revision ACL reconstruction procedure. Graft choice was 42 percent autograft bone-patellar-bone, 31 percent autograft soft tissue and 27 percent allograft.

Patients completed a preoperative series of validated outcome instruments, including the International Knee Documentation Committee (IKDC) and Knee injury and Osteoarthritis Outcome Score (KOOS) (Figure 1).

OUR RESEARCH ADDS TO SHORT- AND LONG-TERM STUDIES THAT SHOW A GOOD PROGNOSIS FOR SPORTS FUNCTION AND QUALITY OF LIFE.

Both IKDC and KOOS scores significantly improved after two years and were maintained at six and 10 years.

Two-year follow-up was obtained for 1,379 patients (57 percent male; median age 23 years), six-year follow-up for 1,375 patients and 10-year follow-up for 1,320 patients.

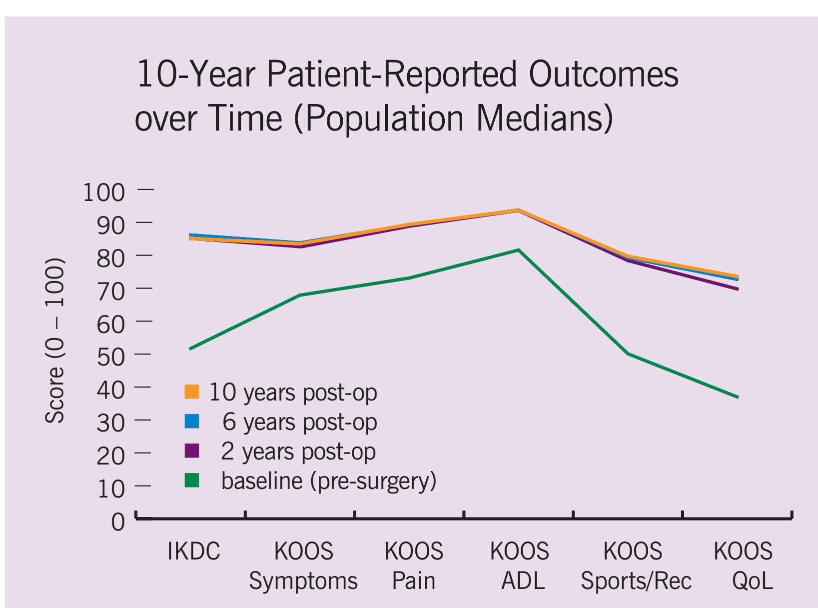

Figure 1

Both the International Knee Documentation Committee (IKDC) and Knee injury and Osteoarthritis Outcome Score (KOOS) scores significantly improved after two years and were maintained at six and 10 years. (ADL=activities of daily living, QOL=quality of life.)

TABLE 1. SIGNIFICANT PREDICTORS FOR WORSE OUTCOMES 10 YEARS AFTER ACL RECONSTRUCTION

	IKDC	KOOS SPORTS/REC	KOOS QOL	MARS
Low baseline IKDC score	■	■	■	■
Low baseline activity level	■		■	■
Older age		■	■	■
Gender (female)	■	■		■
Higher body mass index	■	■	■	■
Smoker	■	■	■	
Lower education level	■			■
Revision ACL surgery	■	■	■	
Previous medial meniscus surgery	■	■	■	■
Previous lateral meniscus surgery			■	
Anterior cruciate medial pathology (grades 3/4)	■	■	■ (grades 2/3/4)	
Anterior cruciate lateral pathology (grades 3/4)	■	■	■ (fracture lines)	
Anterior cruciate patellofemoral pathology (grades 3/4)	■	■	■	
High-grade laxity				■
Subsequent surgery (ipsilateral knee)	■	■	■	

IKDC=International Knee Documentation Committee; KOOS SPORTS/REC=Knee injury and Osteoarthritis Outcome Score sports and recreation; KOOS QOL=Knee injury and Osteoarthritis Outcome Score quality of life; MARS=Marx Activity Rating Scale

The latter represents 83 percent of the original study group, making this the first prospective ACL reconstruction cohort with over 80 percent follow-up at 10 years.

Subsequent surgery data obtained on over 90 percent of the cohort

Interestingly, Marx Activity Rating Scale (MARS) scores dropped markedly over time. Significant drivers of poorer outcomes included lower baseline scores prior to surgery, higher body mass index, smoking, a history of medial meniscus surgery prior to ACL reconstruction, having a revision ACL reconstruction, grades 3-4 articular cartilage pathology, and having any subsequent ipsilateral surgery. Graft type, medial collateral ligament or lateral collateral ligament pathology, and medial and lateral meniscus surgery at the time of ACL reconstruction were not found to be significant risk factors (Table 1).

ACL injury not devastating, just a setback

An active patient may view an ACL injury as devastating, but our research adds to short- and long-term studies that show a good prognosis for sports function and quality of life. This study can help medical providers continue to make good treatment decisions, and to present these injuries as simply a setback. The prognostic information will aid in setting the patient's expectations after ACL reconstruction and in counseling to emphasize that managing modifiable risk factors will significantly influence their outcome.

Dr. Spindler presented this study at the 2017 American Orthopaedic Society for Sports Medicine's annual meeting. He and the MOON group were recognized with the society's O'Donoghue Sports Injury Research Award for best overall clinical research paper. Findings were published in the *American Journal of Sports Medicine*.

Dr. Spindler is an orthopaedic surgeon and Vice Chairman of Research, Cleveland Clinic Orthopaedic & Rheumatologic Institute.

Reference

MOON Knee Group, Spindler KP, Huston LJ, et al. Ten-year outcomes and risk factors after anterior cruciate ligament reconstruction: a MOON longitudinal prospective cohort study. Am J Sports Med. *2018 Mar;46(4):815-825.*

ACUTE FLACCID MYELITIS: A MODERN-DAY POLIO?

IN OTHERWISE HEALTHY CHILDREN, DEVASTATING AND PERMANENT PARALYSIS CAN OCCUR

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Acute flaccid myelitis (AFM) is a recently described rare condition primarily affecting otherwise healthy children. It is characterized by muscle weakness and myelitis of the spinal cord's anterior horn cells following a viral illness.

While it affects the motor function corresponding to the inflamed spinal levels, presentation can be a skip-lesion type pattern, with preservation of function proximal and distal to the affected levels. Sensation remains intact for these children because the myelitis, similar to polio, is limited primarily to the gray matter.

The virus most commonly implicated in AFM, but not always identified, is enterovirus. In the United States, a 2014 outbreak of D68 enterovirus respiratory illnesses was associated with a cluster of AFM cases in Colorado and California. Similarly, in Australia and East Asia, AFM has been associated with outbreaks of enterovirus D71.[1]

Making the diagnosis

Children with AFM typically present with acute onset of asymmetric flaccid paralysis, often rapidly progressing from normal strength to flaccid weakness with loss of reflexes within hours to a few days. A prodromal illness (typically febrile with respiratory symptoms) a few days prior to the onset of flaccid paralysis is common. Perplexingly, the respiratory symptoms of the prodromal illness are frequently shared by sick contacts within the household, but they are spared any signs or symptoms of AFM. Patients also frequently report pain in the affected limb at the time of weakness onset. There do not appear to be any ethnic or racial predispositions or pre-existing comorbidities that place these healthy children at increased risk or any association with vaccination status.[2]

AFM differs from more common viral neuropathies such as transverse myelitis and Guillain-Barré. Transverse myelitis has deficits in both motor and sensory function at the affected spinal levels while Guillain-Barré is typically symmetric and ascending in its motor and sensory impairment.

When making the diagnosis of AFM, the clinician frequently orders many tests, but they rarely help. Lumbar punctures will frequently demonstrate pleocytosis (74 percent) and some protein elevation (48 percent), but rarely yield an infectious organism.[3] Current Centers for Disease Control and Prevention (CDC) definitions of AFM require two criteria:

- Acute onset of flaccid limb weakness.
- MRI evidence of a gray matter lesion spanning one or more spinal segments.

A lumbar puncture demonstrating pleocytosis can make the diagnosis of AFM probable when in combination with acute-onset limb flaccid weakness, but is not definitive for the condition.[4]

What to do: Report and refer

AFM, although potentially devastating, is a rare condition. According to the CDC, there were 120 cases nationwide between August and December 2014. In 2015, there were only 21 cases. Another spike occurred in 2016 with 149 cases. In 2017, the number of confirmed cases dropped to 23.[5] If there is a biannual cycle in AFM, another spike is expected in 2018, although it is too soon to say. Reporting suspected cases to the CDC will assist with surveillance and improve our understanding of this devastating condition.

TIMELY RECOGNITION OF AFM AND REFERRAL TO A CENTER FAMILIAR WITH IT IS ESSENTIAL TO PREVENT THIS DISEASE FROM BECOMING A 21ST CENTURY RESURRECTION OF POLIO.

Treatment strategies

In the acute setting, supportive care is critical. The flaccid paralysis can involve the diaphragm, so careful monitoring for respiratory distress is crucial.

Many children with AFM will demonstrate some improvement in function, but most will have persistent weakness for months to years. Unfortunately, there are no predictive factors to determine final functional status. Evidence suggests the long-term prognosis for AFM is worse than that for similar conditions such as transverse myelitis. Nerve

Figure

A child with AFM affecting the proximal muscles in his right upper extremity. Note the muscular atrophy in his supraspinatus fossa, deltoid and biceps. (*Pictures courtesy of the Shriner's Hospital for Children, Philadelphia, where Dr. Styron completed a fellowship in Pediatric and Congenital Upper Extremity Surgery.*)

transfers may be an effective strategy to restore function in affected extremities when potential nerves are available to transfer. Some patients have experienced a restoration of function in muscles that underwent nerve transfers and persistent weakness in muscles for which no viable transfer options were available.[6]

Similar to polio, the anterior horn cells are affected in AFM, causing a lower motor neuron deficit. Muscle groups that fail to recover within six months rarely do recover, resulting in residual paralysis. However, some children have continued to improve for two years.[1] This creates a quandary for parents and providers. Waiting beyond one year to perform nerve transfers limits their efficacy based on the established paradigm of permanent motor endplate demise following 18 to 24 months of denervation. Therefore, referral to a specialist familiar with AFM and who is capable of performing nerve transfers is recommended within six months to one year of symptom onset.

Timely recognition of AFM and referral to a center familiar with AFM are essential to prevent this disease from becoming a 21st-century resurrection of polio.

Dr. Styron is staff in the Department of Orthopaedic Surgery where he specializies in congenital, pediatric and adult hand and upper extremity surgery.

References

1. *Anderson EW, Kornberg AJ, Freeman JL, et al. Acute flaccid myelitis in childhood: A retrospective cohort study. Eur J Neurol. 2017;24(8):1077-1083.*
2. *Messacar K, Schreiner TL, Van Haren K, et al. Acute flaccid myelitis: a clinical review of US cases 2012-2015. Ann Neurol. 2016;80(3):326-338.*
3. *Van Haren K, Ayscue P, Waubant E, et al. Acute flaccid myelitis of unknown etiology in California, 2012-2015. JAMA. 2015;314(24):2663-2761.*
4. *Hopkins SE. Acute Flaccid Myelitis: Etiologic challenges, diagnostic and management considerations. Curr Treat Options Neurol. 2017;19(12):48-54.*
5. *Centers for Disease Control and Prevention (CDC). AFM in the United States. Internet, Accessed March 16, 2018. Available from: https://www.cdc.gov/acute-flaccid-myelitis/afm-surveillance.html*
6. *Funahashi S, Nagano A, Sano M, Ogihara H, Omura T. Restoration of shoulder function and elbow flexion by nerve transfer for poliomyelitis-like paralysis caused by enterovirus 71 infection. J Bone Joint Surg Br. 2007;89(2):246-248.*

LATEST TECHNIQUES TO ADDRESS CHALLENGES IN RECURRENT ANTERIOR SHOULDER INSTABILITY

PRESHAPED ANATOMIC ALLOGRAFT GLENOID RECONSTRUCTION

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Recurrent anterior shoulder instability continues to be a challenging clinical entity due to high complication rates. But this challenging scenario is also driving the development of creative new treatment options.

Background

First-time shoulder dislocations result in significant glenoid and humeral head bone defects, both of which tend to be aggravated in recurrent dislocations with anteroinferior glenoid rim deficiency of up to 90 percent. The pooled rate of recurrence after primary anterior shoulder instability is estimated to be 21 percent. The incidence of primary anterior shoulder dislocations has been reported as 26.9 per 100,000 person years in the U.S. for both primary and recurrent dislocations, resulting in more than 80,000 emergency department visits.

Addressing glenoid and humeral defects

Both glenoid and humeral defects should be addressed to optimize surgical outcomes, avoid nonphysiological stress to the repair and improve the effectiveness of instability procedures. Previous studies demonstrate that humeral head defects of > 25 percent require surface reconstruction. Similarly, glenoid defects larger than 15 to 20 percent require bony reconstruction, particularly with concurrent humeral head defects. Prognostic factors such as young age and competitive participation in contact sports substantially increase the recurrence risk and demand reconstruction of both humeral and glenoid bone deficiencies.

Shift from Bankart to Bristow and Latarjet, but improvements still needed

Over the past decade, arthroscopic Bankart repairs have fallen out of favor due to higher failure rates, and attention has shifted to bony procedures. Bristow and Latarjet procedures are considered the gold standard for recurrent anterior shoulder instability. However, systematic reviews report an overall complication rate of 30 percent. Perioperative complications include neurovascular injury, hematoma, infection, coracoid fracture, graft mismatch, malalignment and procedure failure.

Postoperative complications of persistent instability, redislocation or subluxation most often occur in the first postoperative year. Nonunion or osteolysis of the coracoid graft and hardware complications drive revision and reoperation rates. Limited mobility or loss of range of motion, including subscapularis deficiencies, persistent pain and high rates of radiographic degenerative changes, all warrant the search for alternative approaches.

Advocates of the Latarjet technique attribute the success of the procedure not only to the bony buttress at the anterior glenoid, but also to the sling effect created by the conjoined tendon. Studies from Mayo Clinic and Cleveland Clinic have shown that repairing the bony deficits on both sides of the joint will restore 100 percent of inherent shoulder stability. In addition, no clinical differences have been shown between the Bristow and Latarjet procedures in augmentation of anterior glenoid bone loss with and without the soft tissue sling.

TO DATE, OVER 20 PATIENTS WITH RECURRENT SHOULDER INSTABILITY HAVE UNDERGONE THE PROCEDURE AT OUR INSTITUTION.

Standardizing procedures to address challenges

The goals of new surgical solutions are to reduce the complication rate; lower the learning curve, technical demands and procedure time; and avoid the deficits and complications of nonanatomic procedures. Reproducibility of new techniques is key to the success of novel approaches. Multiple graft sizes, anatomical shapes, an instrumented guidance system that facilitates glenoid preparation, graft positioning, screw placement, suture management and soft tissue repair all play an important role in the standardization of the procedure, with the potential to minimize complications and optimize outcomes.

Enter off-the-shelf implants

Recently, preshaped, predrilled human cortical allograft implants (Glenojet™ Latarjet Allograft System; Arthrosurface, Franklin, Massachusetts) have been introduced to address some of the aforementioned challenges (Figure 1). The off-the-shelf sterile grafts are available in two sizes (10 mm by 29 mm, and 13 mm by 34 mm) and are contoured to match glenoid geometry. The smaller graft is more commonly used to reconstruct defects of 20 to 30 percent of the glenoid. The larger graft allows for glenoid reconstruction beyond 30 percent bone loss.

An attractive alternative

The combination of guided instrumentation and preshaped/predrilled grafts greatly reduces conventional Latarjet surgical procedure time and technical difficulties (Table 1). The surgeon uses a deltopectoral approach to expose the anterior glenoid through a subscapularis split or tenotomy. A cannulated guide determines the position and orientation of two parallel pins, which produce a flush anterior glenoid surface preparation (Figure 2) and facilitate graft placement and orientation of two bicortical glenoid fixation screws (Figures 3, 4). The ease of the technique makes this an attractive alternative for glenoid reconstruction in bony Bankart lesions or failed Bristow/Latarjet procedures.

TABLE 1. BENEFITS OF PRESHAPED, PREDRILLED ALLOGRAFT RECONSTRUCTION

BENEFIT	EXPLANATION
Shorter operative time	Less surgical dissection than a traditional coracoid bone transfer
Technically less demanding	Guided instrumentation
Reproducible congruency and fit	Preshaped, predrilled grafts
Multiple sizes	Accommodates the spectrum of glenoid bone loss beyond 25 percent
Reduced risk of neurovascular injury	Shorter procedure and guided instrumentation
Preservation of glenohumeral anatomy	Avoids distortion of the anatomy and facilitates future revision procedures, including shoulder arthroplasty

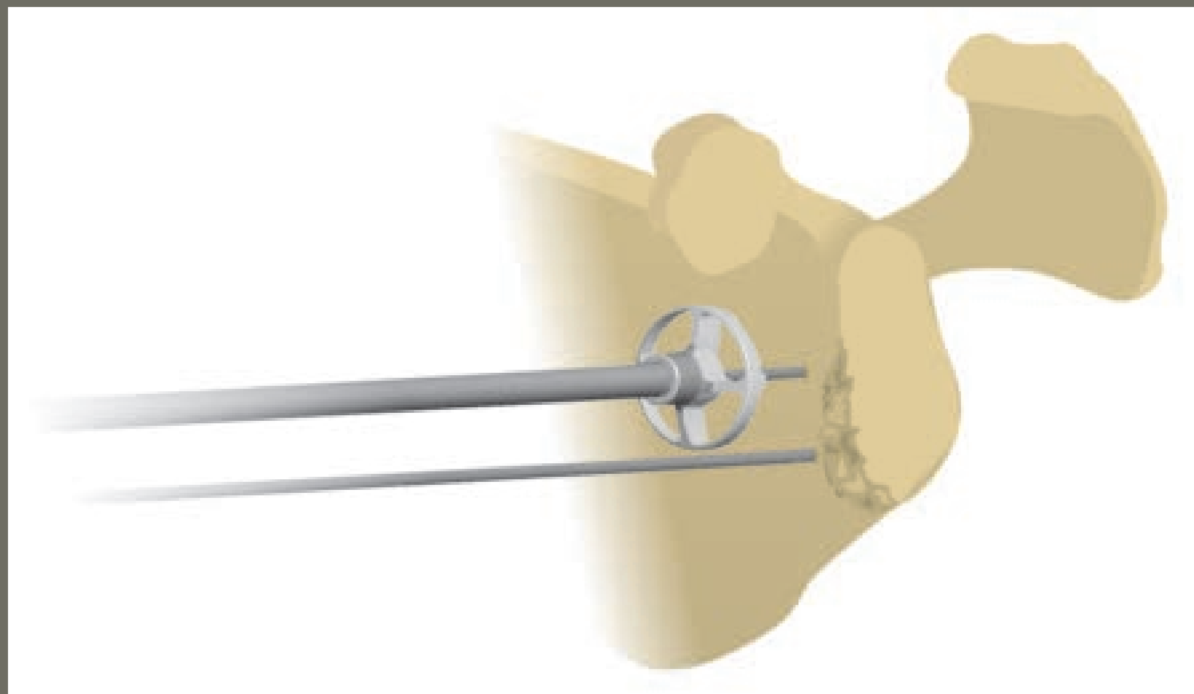
Figure 1

Allograft bone preshaped to fit glenoid anatomy, and predrilled for screw placement, fixation and sutures as required.

for

Figure 2

Surface preparation of the anterior glenoid face. *(Illustration courtesy of GlenoJet, © 2018)*



Cleveland Clinic experience

To date, over 20 patients with recurrent shoulder instability have undergone the procedure at our institution. Most had failed previous stabilization procedures. Short-term follow-up of 12 to 24 months is promising, with no evidence of clinical failures and no episodes of recurrent instability. With any bone grafting procedure, there are likely to be issues with nonunion or resorption. But early clinical results are good and show reduced neurologic risks.

We have found that this novel approach to anterior glenoid reconstruction is technically easier to perform, affording less surgical dissection than traditional coracoid bone transfer procedures. Short-term outcomes are reassuring, though higher case volumes and longer follow-up are needed to assess its clinical effectiveness in recurrent anterior shoulder instability.

Dr. Miniaci is Professor of Orthopaedic Surgery, Center for Sports Health. He has extensive experience in shoulder and knee reconstruction and cartilage resurfacing and speaks frequently at national and international meetings and events. Dr. Miniaci reports that he receives financial support (consultant fees, speaker fees, honoraria, royalties, stock options) from Arthrosurface Inc.

References

Griesser MJ, Harris JD, Miniaci A, et al. Complications and re-operations after Bristow-Latarjet shoulder stabilization: a systematic review. J Shoulder Elbow Surg. *2013;22(2):286-292.*

Delaney RA, Freehill MT, Janfaza DR, et al. 2014 Neer Award Paper: neuromonitoring the Latarjet procedure. J Shoulder Elbow Surg. *2014;23(10):1473-1480.*

Provencher MT, Frank RM, Golijanin P, et al. Distal tibia allograft glenoid reconstruction in recurrent anterior shoulder instability: clinical and radiographic outcomes. Arthroscopy. *2017;33(5):891-897.*

Smucny M, Miniaci A. A new option for glenoid reconstruction in recurrent anterior shoulder instability. Am J Orthop. *2017;46(4):199-202.*

Figure 3

Bone graft fixed in place with two screws.

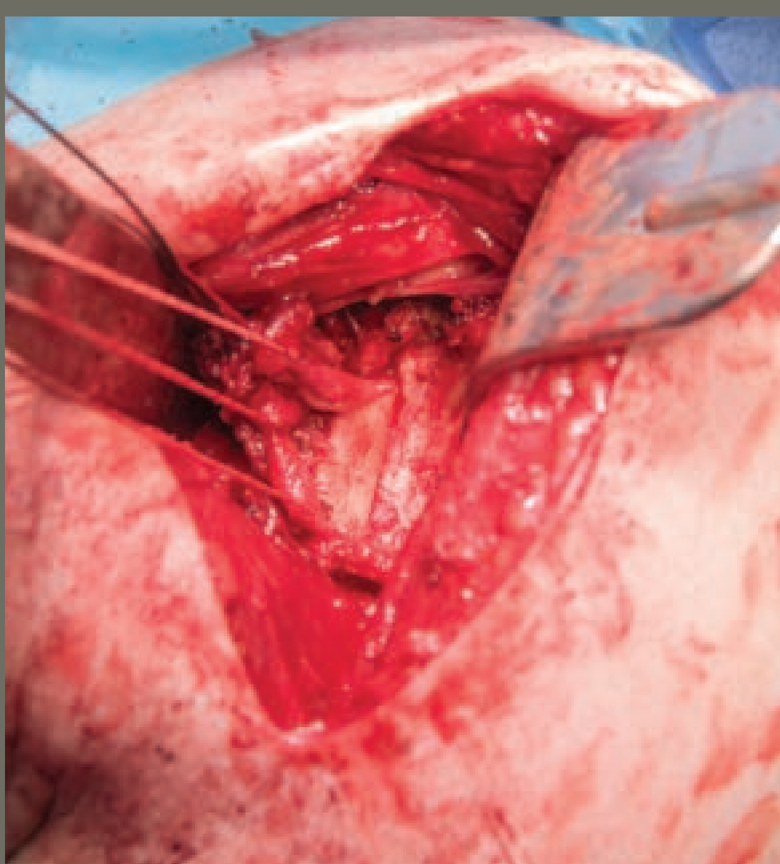


Figure 4

Capsule repaired to bone graft.

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