Wrist Case Study

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In the sport of gymnastics, upper extremity is subject to weight bearing that is above normal levels for ADL and non-gymnasts. (1, 2, 4, 5). Because of this, stress in placed through the wrist that may result in a higher occurrence of injuries as compared to non-upper extremity weight bearing athletes (1, 3).

Wrist pain in artistic gymnastics is widespread due to angle of the wrist in weight bearing (2,5) , dichotomously the tension on the wrist in hanging (7), quick force/impact on soft and hard surfaces (2,7,8), and at the advanced levels, rotation that the wrist endures in closed chain handstand position (8).

The cause of chronic wrist pain can be due to the differential between PROM in open chain and PROM in CC weight bearing. In general, gymnasts are subject to 90 degrees of a CC angle between the vertical handstand (forearm) and the hand as it is approximating with the floor or balance beam. In the case of front tumbling skills (8) and vaulting (specifically Yerchenko entry positions) (8) , the angle of the wrist may be from 50 degrees to in excess of 100 degrees at departure phase from vault contact. The upper extremity can experience 2.2x body weight in compressive forces (8)

Compensations can be made by a combination of ulnar deviation and external rotation of the Glenohumeral joint in order to avoid full closed chain wrist extension. Excessive forces in wrist extension and ulnar deviation may lead to injuries such as TFCC stress and an increase in ulnar variance (1,2,3,4,8)

Theory: It is evident in many optional level gymnasts that poor shoulder flexibility leads to many body compensations, both distal to the GH joint in the UE as well as at the ribs, spine and hips. The handstand position, whether straight or tight-open arch, is where the athlete performs inverted plyometric activity (such as tumbling and vaulting). If the shoulder flexion available range of motion (AvROM) is not to at least 180 degrees (vertical), the shoulders have a non-complete flexed position, as well as predisposing themselves to ER and the GH joint, resulting in excessive forces on the carpal joints and the DRUJ. This carries over to balance beam, where the standard of hand placement is tandem with in ulnar deviation. The ulnar deviation angle can be decreased as the shoulder gets closer to full flexion with external GH rotation. As well, the difference between a supine measured GH flexion, without compensation of rib tilting or lordosis, and the strength component of shoulder flexors, measured prone without compensation, may contribute to these increased forces on the wrist joint. If the athlete has the available range of shoulder flexion but is not able to utilize this range during motion activity (such as the arm swing phase of pre-weight bearing in a back handspring or a Yurchenko), then compensations at the spine, shoulder, elbow and wrist take place. The larger the shoulder flexion PROM, the less likely an athlete is to experience wrist pain from shoulder flexibility compensation. As well, the smaller the differential between the PROM supine and the AROM prone, the more AvROM the athlete is functionally using, therefore, the less likely to have compensatory wrist pain.

The athlete in this case study is a 17 year old female artistic gymnast who is a first-year USA Gymnastics J.O. Level 10. She began gymnastics, rhythmic, at the age of 4, and transitioned to artistic at the age of 10. She has been performing Yurchenko vaults since she was 13, and plyometrically tumbling since she was 11. She performs rotational skills in UE weight bearing (blind changes) on her L wrist (stationary). She first complained of wrist pain (general ache) when she was 13 years old, at the time when she was performing back handsprings on balance beam and front handsprings on vault with a good block. At this time, the wrist pain was never treated, and subsided independently. Currently, she is began complaining of wrist pain, left only, 9/10 with weight bearing plyometrics, 8/10 during uneven bars blind changes, and 8/10 with palpation to distal radius or ulna. Grip strength lead as well to a 7/10 reported pain with max compression. In evaluation testing, she had pain with supination past 15 degrees in weight bearing, open and closed chain ulnar deviation past 9 degrees, and pain with forced extension past 41 deg.

	Wrist Flex	Wrist Ext	GH Flex Supine	GH Flex Prone	GH ER	GH IR	Wrist Pro	Wrist Sup	
Left	62	51	n/a	n/a	93	68	93	88	
Right	80	72	na/	n/a	94	66	94	87	
Bilateral Measurement	n/a	n/a	139	134	n/a	n/a	n/a	n/a	

Treatment consisted of 7 part rehabilitation. The first was edema reduction at the radiocarpal and ulnocarpal joints using Iontophoresis treatment with dexamethazone medicaion applied to a topical take-home patch for 18 hours, 3 treatments on each side separated each by 3 days. The patient also received joint mobilization of the carpal bones and each articular surface in a P/A fashion. Graston Technique was performed to the anterior portion of the forearm for release of the flexor tendons, which are used more in gymnastics forgrip and balance than the extensors, as well as blood flow increase for tone reduction in the muscles. This was

performed for 5 minutes at every session in both proximal to distal and reverse motions. Active Release Techniques was performed to proximal and distal attachments, as well as central muscle body, of the wrist flexors, extensors, forearm pronators and supinators, as well as radial and ulnar deviators. This was performed between 2-5 repetitions both intera- and inter-muscularly, for 8 sessions. The fifth technique used was passive range of motion/stretching for wrist flexion and extension, with all stretches held for 45 seconds. The patient performed these 2x/day for 21 days, 6 days/week. The sixth hands-on treatment that the patient received was ART and passive stretching of the shoulder extensors to increase PROM and AROM of shoulder flexion. This was done supine for ART. The stretches were done lying prone on the floor with the arms grabbing a bar on the wall approximately 10" form the floor, keeping the elbows straight. The second focused stretch was in a back bend with partner's help, assisting axial opening (see figure 3) The patient performed open chain wrist strengthening including grip strength on a resistance web, wrist flexion, extension strength using free weights, and pronation and supination using a 2lb bar. The patient also performed shoulder strengthening specifically for the shoulder flexors and parascapular muscles. This was done in prone position off the end of a table using a weight bear, from 90 degrees of GH flexion to as close to 180 degrees as possible. GH horizontal abduction was also performed on an exercise ball, 3x15 with varied weights. Standing resistance band work was done for shoulder flexion, bilaterally, standing on the band and holding ends in each hand.

Examples of supine and prone shoulder flexibility testing

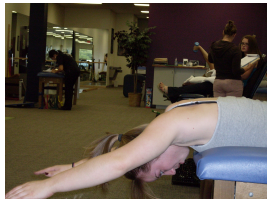

Figure 3- Stretch

As the athlete gradually returned to weight bearing, she also wore Tiger Paws, a prophylactic wrist bracing system meant to decrease the sharpness of the angle and the pressures at the ulnocarpal and radio-carpal joint. Research has suggested (6) that bracing decreases the wrist joint dorsiflexion angle as well as ulnocarpal joint intraarticular peak pressures.

Currently, the athlete reports pain of 1/10 with partial weight bearing in push up position, pain free resistance strengthening work, and return to 50% of repetitions of tumbling and vaulting. She has no reported pain during blind changes on uneven bars or the grip change portion of pirouettes. Post-treatment measurements include shoulder flexion supine of 162 and prone of 159, leading to a strength difference of 3 degrees.

The patient is more functional and complains of less pain after treatment, which was non-traditional and focused on shoulder strengthening and stretching to address the biomechanics issues related to assumed stress on the wrist.

Suggested research in the future consists of exact measurement of the split of forces between the GH joint flexion, GH joint ER, proximal supination/pronation, distal supination/pronation, wrist extension, and ulnar and radial wrist deviation. Predispositions to TFCC tears may be able to be predicted, especially on dominant weight bearing hand of upper level athletes during uneven bar skills such as pirouettes and blind changes, and bilateral skills such as front and German giants. Predictability to wrist pain in regards to ulnar variance may be present if films are taken at the early stages of distal radius/ulna length differential and focus in places on proper mechanics including shoulder flexibility.

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