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Non-Operative Treatment of High Ankle Sprains: an 18+ Year Case Series Follow-Up Study

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Thank you!!!!

*** ATSNJ Grant 2022 - 02**

Disclosures:

- I WISH I had relevant disclosures that I could make.
- No disclosures

- This study has been accepted for a podium presentation at the AOSSM in July 2024.

- Results have been submitted for publication.

Brief Backgrour

- 11-75% of all ankle s
- Chronic pain, functior
  ankle trauma is assoc
- Treatment non-opera
  - Varying degrees of inj
    - Frank/latent diastasis
    - Associated Fracture

Treatment Dilemma

What is the long-term impact of care on HAS?

- Clinical findings
- Cast vs boot vs Splint
- Weight bearing vs non
- Secondary injury?
  - Cartilage, HO,

- 1 vs 2 restraints
- Arthroscopy first?
- Immobilization time post op
- Re-operation rate?
- Infection?
- Over tightening?

Objectives:

- Document incidence of re-injury
- Need for surgical intervention
- Incidence of OA
- Long-term function/outcome

Hypothesis:

- Non-Operative treatment utilizing a standardized protocol will result in good long-term outcomes
- *As determined by PROMs, K-L Scoring, Need for assistive devices

- Initial tenderness length
- days of initial disability
- medial tenderness
- long-term obesity
    - **will impact outcomes.**

Methods:

- **Patients**
  - Division I collegiate Athletes (60 HAS)
    - Published Study Nussbaum ED, et al AJSM 2001
  - Secondary School Athletes – (20 sprains)
    - Poster Presentation – International Ankle Congress 2006, Lexington, KY

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Article

Prospective Evaluation of Syndesmotic Ankle Sprains without Diastasis *

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Syndesmotic Injury in Adolescents

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Charles J. Gatt, MD – University Orthopaedic Associates, Somerset, NJ

INTRODUCTION

Syndesmotic Ankle Sprains are often referred to as "High Ankle Sprains" (HAS). Clinicians frequently note variability of HAS and extended disability compared to lateral ankle sprains. The purpose of this case series was to characterize the incidence and clinical presentation of HAS in an adolescent population.

STUDY DESIGN

* Case Series

CASE DESCRIPTION

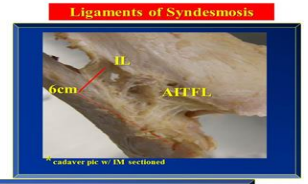
Ankle injuries were evaluated clinically and followed for a 4 year period at a large high school athletic program. Location, severity of injury, prior history, tenderness length and ability to perform a single leg hop test were recorded systematically. Subjects were referred to physician examination and x-ray according to the Otttowa Ankle Rules.

RESULTS

- 358 injuries were reported to 278 athletes. 48 athletes sustained recurrent sprains while 32 suffered bilateral sprains.
- There were 315 lateral injuries (88%), 22 High Ankle Sprains (HAS), 13 medial injuries including 3 avulsion fractures, 7 dorsal capsular sprains and 1 reported bi-malleolar fracture.
- Isolated lateral ankle sprains were the most common 155/358, (43% of total), and were most easily managed. 150/304 (49%) of lateral injuries also demonstrated tenderness above the talocrural joint, over the Anterior Inferior Tibio Fibular Ligament and syndesmosis.
- 183/358 (51% of total) injuries were identified with proximal tenderness. (150 lateral sprains, 22 HAS, 11 w/ isolated fibular tenderness at 4-6cm).
- All with proximal tenderness were unable to perform a single leg hop test from their toes vs. 147/152 (97%) of isolated lateral injured could pass single leg hop testing. (despite degree of injury)
- 141/150 (94%) laterally injured w/ proximal tenderness noted prior ankle injury.
- 22/183 (12%) demonstrated a tenderness length >5cm (Range 6-13cm), (Classic HAS)
- 11/183 (6%) were 15 y/o athletes who demonstrated isolated fibular tenderness 4-6cm with no evidence of ligamentous injury or fracture on xray. (Chief complaint was bony pain at 5-6cm), stable lateral ankle exam w/o tenderness of lateral ligaments. Demonstrated functional disability)

CONCLUSIONS

- There is variation in degrees of syndesmotic injury.
- Syndesmotic injury is common among adolescent athletes.
- Tenderness above the talocrural joint is indicative of injury/irritation. Most were tender above the talocrural joint and measured <6cm indicating a subset of HAS (Low HAS)
- Low HAS are associated with a report of prior lateral ankle injury suggesting that some syndesmotic injuries may be progressional in nature.
- The single leg hop test from toes may be utilized as a functional test that is suggestive of syndesmotic injury.
- In the skeletally immature population ligaments of the syndesmosis may act as a stress riser.



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3) Hoefnagels EM , FAI, 2007 May; 28(5)602-604 PMID 17559768
4) Kim JS, Radiology 2007 January; 242 (1); 225-235 PMID 17185669
5) Nussbaum E, AJSM 2001: 29: 31-35 PMID 11206253

Clinical Exam:

– palpation,

- tenderness length

- DF Ext Rot test (Modified Kleiger test)

- Squeeze test, (Compression at mid lower leg)

- hop test

IMAGING:

- Xray eval – A/P, Lateral view – R/O frank diastasis, fracture

Treatment: "Conservative/Aggressive Approach"

"Conservative/Aggressive" Approach (CAA)			
Rehabilitation Phase	**Duration**	**Treatment/Rehabilitation**	**Progression Criteria**
Phase I: Acute	4 days	Immobilize in neutral posterior splint; NWB, remove daily for modalities, Limited NWB ROM/stretching, Limited Sagittal plane MRE PF N-15%, DF -15-N.	Improvement in swelling/pain, able to bare weight
Phase II: Intermediate		Progress weight bearing as tolerated; increase ROM and strengthening exercises, initiate proprioceptive work, walk through sport movements	May progress to running when patient can do single leg hop x 10 without allowing heel to touch ground. Mentally ready
Phase III: Advanced		Straight ahead running w/o limp, progress to cutting, skipping, jumping; gradually progress sports specific drills (slow-full speed)	May progress activity when can perform running, cutting, sports specific drills without limp, increased pain, mentally prepared to return
Phase IV: Return to sports		Gradually increase intensity/duration of participation, monitor for increased ankle pain	

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Methods Cont:

Contact Method:

- Social Media – Period (6 months: 1/5/23-7/5/23)

Potential Contacts –

- 60 Collegiate Athletes (1993-1997)
- 20 HS Athletes (2001-2003)




Information Collected:

- Online RedCap Survey tool
  - Demographics
  - Notation of subsequent injury
  - Notation of Surgery
  - Completion of PROMs – SEFAS, PROMIS-10
- Additionally:
  - WB Xrays – AP, Lateral, Mortise views evaluated by MSK Radiologist
    - Kelgren-Lawrence Scoring (OA)
    - Jt Congruity Measurements – TFO, TFC, MCS
    - Amount of tibio-talar narrowing
    - Notation of HO, Spurring
    - Lateral tilt of talus

SEFAS

Self-Reported Foot Ankle Score

- questionnaire designed to evaluate disorders of the foot and ankle
- 12 questions
- Validated

SEFAS Questions

1. How would you describe the pain you usually have from the foot/ankle in question? ☐ None ☐ Very mild ☐ Mild ☐ Moderate ☐ Severe	2. For how long how you been able to walk before severe pain arises from the foot/ankle in question? ☐ More than 30 minutes ☐ 16-30 minutes ☐ 5-15 minutes ☐ Less than 5 minutes ☐ Unable to walk at all because of the pain
3. Have you been able to walk on uneven ground? ☐ Yes, easily ☐ With little difficulty ☐ With moderate difficulty ☐ With extreme difficulty ☐ No, impossible to walk on uneven ground	4. Have you had to use an orthotic, shoe insert, heel lift or special shoes? ☐ Never ☐ Occasionally ☐ Often ☐ Most of the time ☐ Always
5. How much has the pain from the foot/ankle in question interfered with your usual work including housework and hobbies? ☐ Not at all ☐ A bit ☐ Moderately ☐ Greatly ☐ Totally	6. Have you been limping when walking because of the foot/ankle in question? ☐ Never ☐ Only one or two days ☐ Some days ☐ Most days ☐ Every day
7. Have you been able to climb a flight of stairs? ☐ Yes, easily ☐ With little difficulty ☐ With moderate difficulty ☐ With extreme trouble ☐ No, impossibly	8. Have you been troubled by pain from the foot/ankle in question in bed at night? ☐ Never ☐ Only one or two nights ☐ Some nights ☐ Most nights ☐ Every night
9. How much has pain from the foot/ankle in question affected your usual recreational activities? ☐ Not at all ☐ A bit ☐ Moderately ☐ Greatly ☐ Totally	10. Have you had swelling of your foot? ☐ None at all ☐ Occasionally ☐ Often ☐ Most of the time ☐ All the time
11. After a meal (sat at table), how painful has it been for you to stand up from a chair because of the foot/ankle in question? ☐ Not at all painful ☐ Slightly painful ☐ Moderately painful ☐ Very painful ☐ Unbearable	12. Have you had a severe sudden pain shooting, stabbing or spasm from the foot/ankle in question? ☐ Never ☐ Only one or two days ☐ Some days ☐ Most days ☐ Every day

PROMIS-10

Patient Reported Outcome Measurement Information System

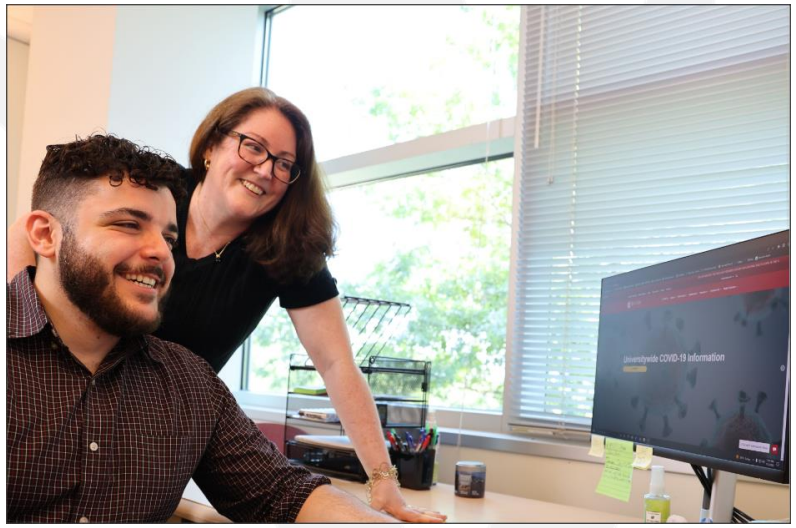
- Measures health status
- Short form; 10 questions

Additional Information

- Initial data set
  - Tenderness length
  - Medial tenderness
  - Days Out
  - Age
  - Sex
  - Sport

**Study size was determined by the number of patients who volunteered to participate in the study.

Statistical Evaluation



- Conducted by Bio-Statistician
  - Rutgers University Biostatistics and Epidemiology
- PROMIS-10, SEFAS scores calculated
- Demographics and Injury History summarized
  - categorical variables were reported as frequencies and percentages
  - continuous variables were reports as ranges, means with standard deviations (SD) and medians with interquartile ranges (IQR).
  - Primary summary statistics and subset analysis were performed
    - Unadjusted logistic regression was performed on the entire sample
    - All statistical analyses were performed using **SAS version 9.4** (SAS Institute, Cary, North Carolina).

Results:

- 74 potential patients Identified (from 2 studies)
- 44/74 (59%) were located and responded to contact
- 31/44 (70%) agreed to participate in the study
  - 24 Collegiate athletes
  - 7 HS athletes
    - 29 Male, 2 Females
    - Mean age - 45 (SD 4.3; range 34-50)
    - Mean Ht - 71.2 inches (SD 4.81; range 57-76)
    - Mean weight was 236.6 lbs (SD 50.8; range 158-350
    - Average follow-up was 25 years (range 18-31 years)
    - 24 football, 4 mens lacrosse, 2 womens lacrosse, 2 mens soccer, 1 wrestling

Results Continued:

Initial injury:

- Mean initial tenderness length 8.6 cm
- Avg RTS – 13 days
- 31/31 – Tenderness AITFL, + Hop Test, no diastasis or fx
- 10/31(32%) of patients demonstrated medial tenderness
- 100% returned to full sports
- 0% had HO @ 6 months
- 30/31(97%) rated their outcome good/excellent
- 10/22(45%) collegiate athletes played professionally (1-9 yrs)
- 3/7(43%) HS athletes played in college

Results Continued:

- 13/31(42%) suffered subsequent ankle injuries
- 5/31(16%) had ankle surgery
  - 2 Achilles tendon ruptures
  - 2 lateral ankle; recurrent lateral injury
  - 1 HO removal
  - *None required stabilization of their syndesmosis
- 4/31(13%)- utilize an ankle brace for athletic activity
- 0% utilized a cane or walker for normal ambulation

PROMs Results

- **SEFAS**
  - 42.68 (SD 5.86; range 29-48)
  - Within normal range
- **PROMIS-10**
  - 36.87 (SD 5.61; range 26-48)
  - Within normal range

Follow-up Xray Results

- 11/31(35%) injuries available for imaging
  - 9 collegiate, 2 high school (11 football athletes)
  - All male
  - Avg age 48 (range 38-50)
  - Mean height was 69.5 inches (SD 7.27; range 57-76)
  - Mean weight was 257 lbs (SD 59.9; range 163-350)
  - Mean **BMI was 37.25** (SD 5.98; range 31.38-48.81)
  - Average time to follow-up **27.3 years** (range 20-29)

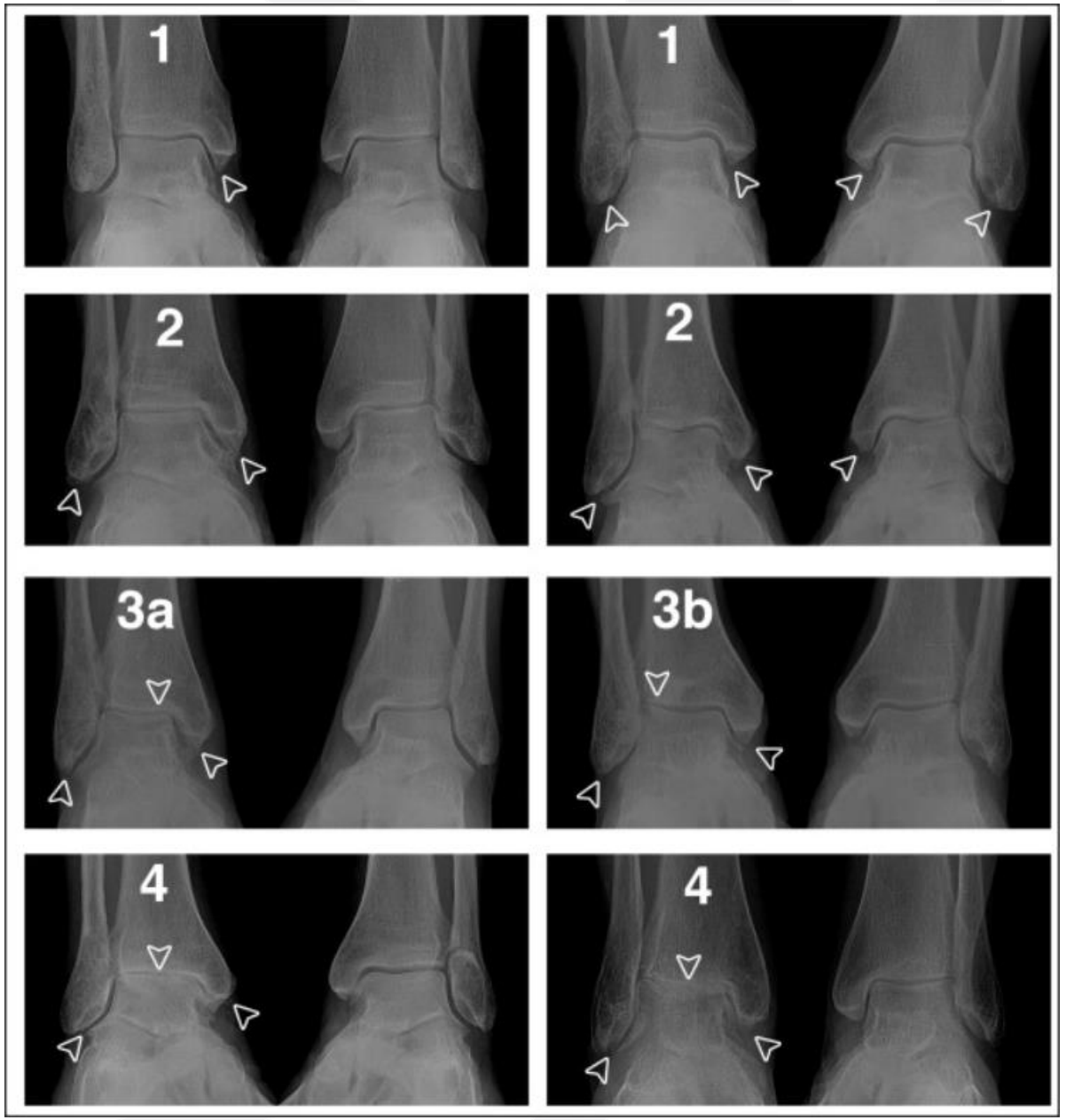
Xray Results Continued:

- 4/11 (36%) demonstrated **evidence of HO**
  - average length of 27.8 mm (range 15-43)
- 10/11(91%) noted they had suffered a **subsequent ankle injury**
  - 1/11 (9%) had undergone surgery (HO removal)
- 8/11(73%) evidence **Osteophyte formation**
- 10/11 (91%) **evidence of OA**
  - 10/10 – evidence at talofibular joint
  - 3/10 – mid tibiotalar joint
  - 1/10 – superior tibiotalar joint
- 2/10 increased talar tilt
  - average of 3.5 mm (range 3-4)

K-L Scoring Results

- Scoring to determine presence/extent of OA
  - Graded I-IV (>2 significant OA)

-Grade I – 4/11(36%)
-Grade II – 4/11 (36%) {8/11(73%)}
-Grade IIIa – 1/11
-Grade IIIb – 1/11
-Grade IV – 1/11 {3/11(27%)}

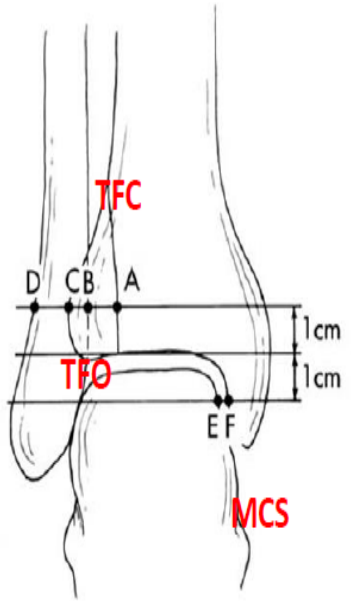


Joint Space Results

- **Mean Tibiofibular clear** space (AP) - 4.5mm (range 2-6.1)
- Mean **tibiofibular overlap** on AP - 7.15mm (range 0-9.9)
- Mean **tibiofibular clear space (mortise)**
  - - 5.64mm (range 4.8-5.9 mm)

Radiographic Measurements

- Tibia fibula relationship
  - Tibiofibular clear space {TFC} (A-B)
    - 1 cm above plafond
    - <6mm AP, mortise
  - Tibiofibular overlap {TFO} (C-B)
    - 6mm or greater
    - < 42% of fibular width
  - Medial clear space {MCS} (E-F)
    - < 2-4mm
  - Measurements may vary w/ positioning



A = Lateral border of posterior tibial malleolus
B = Medial border of fibula
C = Lateral border of anterior tibial prominence
D = Lateral border of fibula
E = Medial border of talus
F = Lateral border of medial malleolus
AB = Tibiofibular clear space
BC = Tibiofibular overlap
EF = Medial clear space

Imaging Summary:

Patient ID	Age	Side	Osteophytes present	OA present on Xray	Location	Talar Tilt	Actual measurement	K-L Score	Tib-Fib Clear Space AP (mm)	Tib-Fib Clear Mortise (mm)	Tib-Fib Overlap AP (mm)	Tib-talar Narrowing%	HO	Length (mm)
7	50	Right	No	Doubtful Significance	Talofibular	<2	0	1	5.3	4.8	7.1	0	No	N/A
11	51	Left	No	No	N/A	<2	0	1	4	5.5	8.5	0	No	N/A
18	49	Left	Yes	Present	Superior, Mid Tibiotalar, Talofibular	<2	1	3a	5.4	7.1	0	25%	Yes	43
19	49	Left	Yes	present	Talofibular	<2	0	2	2.7	5.7	5.2	0	Yes	22
26	38	Left	Yes	Present	Talofibular	<2	0	2	4.9	5.8	8.1	0	No	N/A
27	51	Right	Yes	Present	Mid Tibiotalar, Talofibular	>2	3	3b	6.1	5.9	5.2	25%	Yes	31
28	50	Right	Yes	Doubtful Significance	Talofibular	<2	0	1	2	5.5	8.3	0	No	N/A
28	50	Left	Yes	Present	Mid Tibiotalar, Talofibular	>2	4	4	2.5	5.2	8.6	75%	No	N/A
29	50	Right	Yes	present	Talofibular	<2	0	2	5.5	5.8	9.4	0	No	N/A
31	48	Right	No	Doubtful Significance	Talofibular	<2	0	1	5.6	5.4	9.9	0	No	N/A
31	48	Left	Yes	Present	Talofibular	<2	0	2	5.1	5.3	8.4	0	Yes	15
Summary	**48.5**	**55% Left**	**73% Yes**	**91% Yes**	**91% Evidence of OA over TFL**	**18% >2**		**27% >2**	**4.5**	**5.6**	**7.2**	**27% Narrowing**	**36% with HO**	**27.8**

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Statistical Modeling

- Impact of tenderness length
- Time loss
- Medial tenderness
- BMI
- Surgery
- Reinjury

Modeling Results:

		Outcomes									
		SEFAS (n=31)		PROMIS (n=31)		KL Score (n=11)*		HO (n=11)*		Bone Spurs (n=11)*	
		Parameter Estimate (95% Confidence Interval)	p-value	Parameter Estimate (95% Confidence Interval)	p-value	Parameter Estimate (95% Confidence Interval)	p-value	Odds Ratio (95% Confidence Interval)	p-value	Odds Ratio (95% Confidence Interval)	p-value
Variables	Tenderness Length	-0.19 (-1.16, 0.78)	0.69	0.38 (-0.54, 1.3)	0.4	0.04 (-0.41, 0.48)	0.86	1.25 (0.57, 2.76)	0.58	0.37 (0.095, 1.41)	0.14
	Days of Disability	-0.15 (-0.71, 0.41)	0.58	0.1 (-0.64, 0.44)	0.7	-0.15 (-0.34, 0.05)	0.12	0.96 (0.66, 1.42)	0.85	0.44 (0.17, 1.13)	0.09
	BMI	**-0.57 (-0.87, -0.26)**	**0.0008**	-0.34 (-0.67, -0.0005)	0.0497	-0.02 (-0.15, 0.01)	0.68	0.89 (0.67, 1.17)	0.39	0.92 (0.74, 1.16)	0.49
	Surgery	2.67 (-4.07, 9.4)	0.41	3.25 (-2.88, 9.38)	0.27	1.10 (-1.26, 3.46)	0.32	Model did not converge	-	Model did not converge	-
	Reinjury	0.82 (-3.61, 5.25)	0.71	0.75 (-3.49, 4.99)	0.72	0.37 (-1.05, 1.78)	0.57	Model did not converge	-	2.00 (0.13, 31.98)	0.62
	Medial Tenderness	**4.9 (0.61, 9.2)**	**0.03**	2.85 (-1.51, 7.2)	0.19	-0.61 (-2.42, 1.20)	0.46	2.00 (0.09, 44.35)	0.66	0.29 (0.01, 6.91)	0.44

Discussion

- Longest study Athletes HAS
- Good clinical outcomes
  - Initial
    - Wide spectrum of injury
    - Documented clinical exam
      - 8.6cm tenderness length
      - 32% medial tenderness
    - Follow-up imaging
      - No HO @ 6 months
    - 30/31 – Good/excellent results
    - All returned to sport
      - 10/22 collegiate played professionally
      - 3/7 – HS played in college
  - Long-term
    - Significant follow-up time
    - Use of PROMS
      - SEFAS, PROMIS-10 WNR
    - Only 4/31 utilized brace for athletic activity
    - 0 utilized cane/walker to ambulate

Discussion

- Re-Injury
- Surgery
- Xray Findings

Discussion Continued:

- **Re-Injury**
  - 42% suffered a repeat injury
  - Ankle injury sports common
    - Rates of re-injury in literature 50-73%
      - Clifton DR, AJSM 2017
      - Mulcahey MK, OJSM 2018
      - Yueng MS, BJSM 1994
    - Chronic injury associated w/ joint incongruity
      - Prakash AA, FA Spec 2020

Discussion Continued:

- **Surgery:**
  - 5/31(16%) – required surgery
    - 2 lateral, 2 Achilles, 1 HO
    - All reported re-injury
    - NONE required syndesmosis stabilization

X-ray Findings

- Heterotopic Oscification
  - Extra-skeletal bone in soft tissue
  - Associated with trauma & soft tissue injury
  - 50-90% of HAS in literature
    - Hopkinson, Boytim, Taylor
  - Alter Fibular motion
    - Synostosis
  - Not well understood
  - Limited data on HO and impact on PROs
- 0 @ 6 months
- 4/11 Xray group
  - All noted re-injury
- 1 surgery for HO removal
- Early unprotected weight–bearing, chronic injury
  - May increase the zone of secondary injury
    - Zalavaras C, J AAOS 2007
- 3/4 (75%) – SEFAS score > average.

X-ray Findings: Osteoarthritis

- 91% had evidence of OA involving TFJ
  - Tibiotalar narrowing was found on 27%.
- 73% < grade 3 K-L grade.
- OA of ankle, not normal part of aging
  - 70-80% associated with trauma/prior injury
    - Bestwick-Stevenson T, Musculos Disord 2021
    - Brown TD, J Ortho Trauma 2006
    - Different than hip, Knee primary origin
  - Collective exposure to various risk factors and physiologic changes
    - Felson DT, Osteoarth Cartil 2013

Osteoarthritis Continued:

- No true general prevalence estimates
- Literature for not robust and lacks quality
  - Estimate 1-15% in general population
    - Picavet HSJ, Annals Rheum Dis 2003
  - Incidence in athletes significantly higher
    - Murray C, Plos One 2018
  - Not associated severity of ankle pain and disability
    - Kloprogee SE, Osteoarth Cart Open 2023
  - Symptomatic OA associated with >K-L gr 2
    - Found in < than 4%
    - Murray C, Plos One 2018
  - **Our Study 3/11 (27%) K-L Grade 3a, 3b, 4**

Risk for OA

- Paucity of risk factors in literature
- **Greater BMI**
  - Greater risk Hip/Knee OA
    - Richmond SA, JOSPT 2013
  - Strong assoc Lower leg issues
- Impact on ankle still inconclusive
  - Negative impact on ankle OA
    - Lee S, J Sci Med Sport 2022
  - Increased risk of ankle tendinitis; non-significant increase OA
    - Frey C ZJ, FAI 2007

Mean Study BMI 37.25 (SD 5.98; range 31.38-48.81)
BMI >30 did NEG impact long-term SEFAS and PROMIS scores

Joint Space:

- TFC (Mortise) 4.5mm
- TFC (AP) 5.3 mm
- TFO (AP) 7.2mm

> Within Normal Range

  - One patient TFO = 0 – may be normal variant
    - Shah AS, FAI 2012

- Talar Tilt – 2/11 – > 2nd Degree
  - Associated with K-L score >2, earlier onset, greater pain
    - Holzer N, Osetoarth Cartil 2012

- **Consistent with our findings (3B, 4)**

Limitations:

- Long-term studies important, but difficult
- Locating, convincing patients to participate often difficult
  - We located 44/75(59%)
- Relatively low numbers N=31, Xrays (11/31)
  - 31/44 (70% agreed to participate)
  - 11/31 were available and willing to come in for Xrays

  - Hard to draw hard conclusions
- Does provide great comparative data for future studies

Additional Limitations

- Lacks Standardized and Accurate Grading Scale
- Lacks use of PROMs
- Lacks X-ray follow up
  - For comparative purposes

Hypothesis:

- ✓ Non-Operative treatment utilizing a standardized protocol will result in good long-term outcomes
- *As determined by PROMs, K-L Scoring, Need for assistive devices

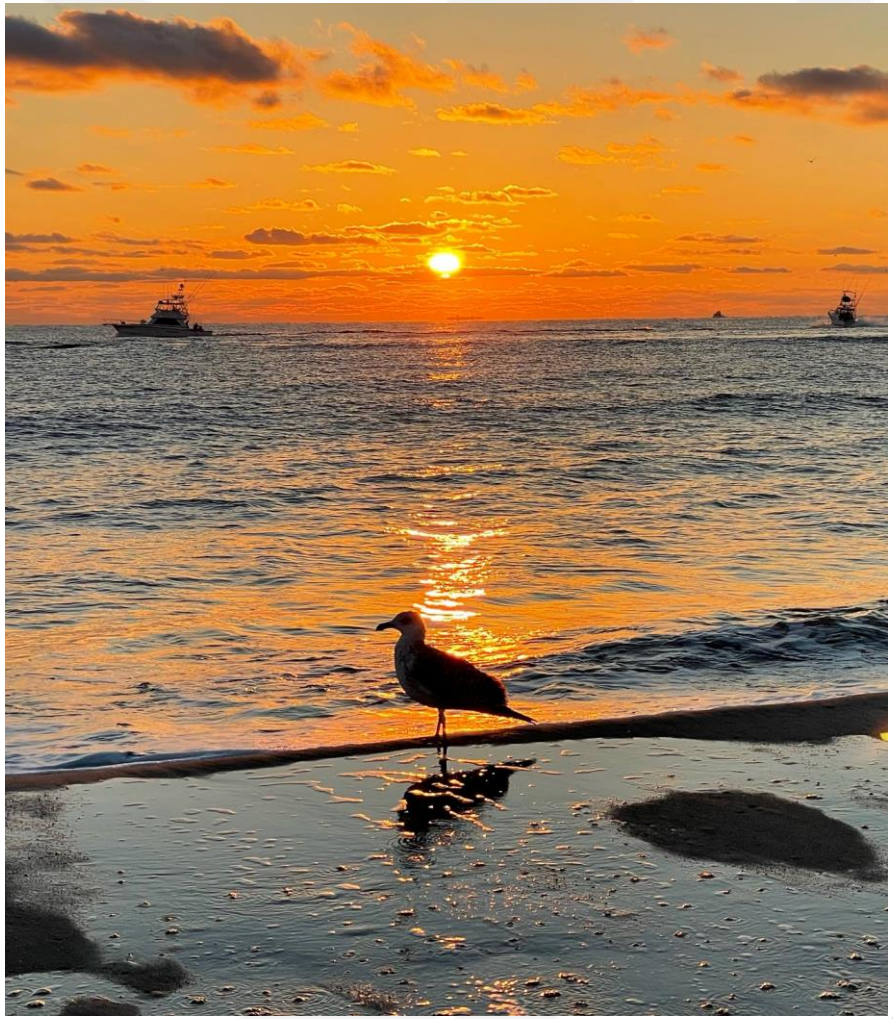
- Initial tenderness length
- days of initial disability
- ✓ medial tenderness
- ✓ long-term obesity
  - **will negatively impact outcomes.**

Conclusion:

- Use of the “Conservative/Aggressive Approach” demonstrates **good long-term outcomes 18+ years later** among an athletic study group.
- Viable treatment option for HAS w/o diastasis or fx
  - Varying degrees of injury
- Modeling data is unique and important
- Clarification of treatment, rehabilitation, including criteria for progression, use of PROMs, Use of imaging are all important to detail.

Food for thought:

- We need more clinical research
- Our Athletic Training rooms are petri dishes
- You don’t need to be a PhD to conduct valuable research
- We need to base care on best available long-term evidence



RUTGERS
Robert Wood Johnson
Medical School

- UOA Sports Medicine Research Group
  - Meet monthly
    - (Usually last Tues of month)
    - In person and via Zoom
  - Multi-disciplined group
  - Discuss ongoing research
    - Process
  - Contact me if you would like to be a part: ericn@uognj.com

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Thank you

Please don't hesitate to email me: ericn@uognj.com