







ORIGINAL

Endoscopic detection of syndesmosis damages in patients with ankle fractures including external rotation

Detección endoscópica de lesiones de la sindesmosis en pacientes con fracturas de tobillo que incluyen rotación externa

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ABSTRACT

Introduction: syndesmosis injury is a frequent and severe complication in the setting of ankle fracture, especially external rotation-type. Early, precise diagnosis is necessary for proper management to avoid long-term disability. Intraoperative Syndesmosis integrity assessment is important in planning the need for surgery.

Objective: the purpose of the research is to assess the efficacy of intraoperative diagnostic techniques in diagnosing Syndesmosis injuries in patients with ankle fractures caused by external rotation, and to evaluate the precision of clinical assessment, imaging modalities, and direct intraoperative evaluation. 100 patients were enrolled in the research to provide credible and statistically significant results.

Method: a group of 100 patients with ankle fracture, i.e., those due to external rotation mechanisms, was evaluated by clinical examination, preoperative imaging (CT scans, MRI), and intraoperative testing (stress tests, fluoroscopy). Surgical exploration was used to confirm intraoperative diagnosis. Sensitivity, specificity, and accuracy of all the methods were compared to decide the most appropriate diagnostic method.

Results: the intraoperative assessment was most accurate in diagnosing Syndesmosis injuries than preoperative imaging and clinical examinations. Stress tests and fluoroscopic control were most useful in detecting subtle syndesmotic disruptions, with a sensitivity of 92,7 % and specificity of 86,7 %. Preoperative imaging had moderate accuracy, while clinical examinations were less accurate in detecting occult injuries.

Keywords: Syndesmosis Injury; Ankle Fracture; Intraoperative Assessment; Sensitivity and Specificity; Fluoroscopy.

RESUMEN

Introducción: la lesión de la sindesmosis es una complicación frecuente y grave en el contexto de las fracturas de tobillo, especialmente las de tipo rotación externa. Es necesario un diagnóstico precoz y preciso para un tratamiento adecuado que evite la discapacidad a largo plazo. La evaluación intraoperatoria de la integridad de la sindesmosis es importante para planificar la necesidad de cirugía.

Objetivo: el propósito de la investigación es evaluar la eficacia de las técnicas de diagnóstico intraoperatorio en el diagnóstico de lesiones de la sindesmosis en pacientes con fracturas de tobillo causadas por rotación externa, y evaluar la precisión de la evaluación clínica, las modalidades de imagen y la evaluación intraoperatoria directa. Se inscribieron 100 pacientes en la investigación para proporcionar resultados creíbles y estadísticamente significativos.

Método: se evaluó a un grupo de 100 pacientes con fractura de tobillo, es decir, aquellos debidos a mecanismos de rotación externa, mediante examen clínico, imágenes preoperatorias (tomografías computarizadas, resonancias magnéticas) y pruebas intraoperatorias (pruebas de esfuerzo, fluoroscopia). Se utilizó la exploración quirúrgica para confirmar el diagnóstico intraoperatorio. Se compararon la sensibilidad, la especificidad y la precisión de todos los métodos para decidir cuál era el método de diagnóstico más adecuado.

Resultados: la evaluación intraoperatoria fue más precisa en el diagnóstico de las lesiones de la sindesmosis que las imágenes preoperatorias y los exámenes clínicos. Las pruebas de esfuerzo y el control fluoroscópico fueron más útiles para detectar roturas sindesmóticas sutiles, con una sensibilidad del 92,7 % y una especificidad del 86,7 %. Las imágenes preoperatorias tuvieron una precisión moderada, mientras que los exámenes clínicos fueron menos precisos en la detección de lesiones ocultas.

Palabras clave: Lesión de la Sindesmosis; Fractura de Tobillo; Evaluación Intraoperatoria; Sensibilidad y Especificidad; Fluoroscopia.

INTRODUCTION

The effective treatment strategy for probable EGC accurate grading is used to assess information based on endoscopy or biopsy. Cancer infiltration intensity is essential when deciding on the treatment mode because the T-stage often determines the criteria for ER and minimally invasive procedures. While inspection can distinguish between the stomach wall's layers, EUS is useful for gastric cancer T-staging.⁽¹⁾ Endoscopic removal of CP has been shown to reduce the risk of CRC, which in around 85 % of cases seems to develop from adenomas using genetic and epigenetic changes.⁽²⁾

Fractions of the ankle often occur with syndesmotic injuries, requiring treatment and stabilization of the fractures more challenging. Painful walking and premature degenerative arthritis are potential complications of untreated chronic syndesmotic instability.⁽³⁾ Perhaps the main requirement for excellent long-term physiological achievement is the rehabilitation of harmony in a Syndesmosis to have become inconsistent.⁽⁴⁾ This trauma, an exceptionally prevalent cause of ankle sprains, is strongly connected to the medical disorder termed ankle instabilities. That's a general phenomenon, appearing high on the list of reasons people attend the emergency room. Although a prominent percentage of individuals who have a sprained ankle can recover totally without any further incident, a maximum of 30 percent of the people who experience it endure long-term consequences.⁽⁵⁾ Despite this, contend that late Syndesmosis instability is significant enough to need passion once instability is discovered. In this investigation, the precise identification of Syndesmosis instability in rotational ankle fractures was the primary focus.

The objective of was to determine whether distal tibiofibular Syndesmosis regeneration using an autogenous tendon for chronic Syndesmosis damage resulted in a substantial improvement in subjective complaints and independent values.⁽⁶⁾ The IOL could represent an excellent option for restoration after chronic Syndesmosis damage. The research of was to scientist's utilized mask for endoscopic scans to automate the detection and categorization of stomach cancer lesions.⁽⁷⁾ The research showed could identify with appropriate sensitivity while generating fewer false positives. Additionally, segmentation accuracy was excellent in the stomach cancer area. These findings suggest the suggested technique has promise as a supplementary tool for endoscopic analysis. Research the steel screw attachment has been the preferred stabilizing method for ankle Syndesmosis.⁽⁸⁾ Nonetheless, there is ongoing discussion on the ideal number and size of anchors, as well as the number of cortexes implicated the height of the screws above the bony plafond, the necessity of breaking bad habits, and the best time to remove the screws. Malreduction linked to tibiofibular syndesmosis has been identified as a major problem with screw fixation. Using one screw or two implants to repair syndesmotic damage at ankle fractures did not significantly differ from one another. Despite this, currently aren't any anterior bones or soft-tissue impingement, but it continues to alleviate ankle discomfort. Research AI is described as an activity-related discomfort in the front portion of the ankle that is triggered by probing of the cartilage line.^(9,10) Arthroscopic excision of infringement tissue is the gold standard due to its high success rate and low incident rate. The impact of chronic ankle instability on the results of conservative therapy should be explored in future investigations. Research Rotated ankle instability can be effectively treated by endoscopic all-inside restoration of the ankle's anterior and midline ligaments.⁽¹¹⁾ The objective of was to as a consequence of

their relative unfamiliarity, Loughborough injuries, a kind of ankle injury, are frequently ignored along with misinterpreted.⁽¹²⁾ The diagnosis can typically be made with only an X-ray, but a CT scan is needed to see the fracture pattern properly. The goal was to ankle fractures occur for just over three percent of all athletic ankle injuries.⁽¹³⁾ The best approach to top athlete development requires accommodating a requirement for rapid and risk-free recovery from extended inactivity. Research these three sportsmen exhibiting damage to the PTT sheath's fibrocartilaginous substrate underwent surgical repair.⁽¹⁴⁾ Diagnosing the connection between the two compartments was aided by doing an ankle arthroscopy and PTT endoscopy simultaneously. All patients had the pinhole connection surgically closed and then immediately resumed their pre-injury sports routines without any further complications.⁽¹⁵⁾ The objective of was to Treatment of acute ligament splits using an advanced endoscopically assisted approach incorporating FHL tendon transfer provided a reasonable and similar return on investment criteria and clinical outcomes with minimum difficulties, according to results in the present analysis.

METHOD

To assess the efficacy of these intraoperative diagnostic methods (stress tests and fluoroscopy) in diagnosing Syndesmosis injuries intraoperative, as compared to conventional preoperative imaging and clinical examination is the aim of the research. The objective is to determine a more accurate method for diagnosing Syndesmosis damage, which can ultimately inform surgical intervention and enhance patient outcomes. The research recruited 100 patients with external rotation fractures of the ankle and provided a strong basis of analysis with statistically valid conclusions regarding the diagnostic value of these tests.

Participants

Patients involved with fractures of the ankle due to external rotation mechanisms. Participants were recruited on the basis of confirmed diagnosis, age ranging from 18 to 65 years, and no history of ankle surgery or joint pathology. Patients with coexisting fractures, bilateral injury, or contraindications were excluded. Fracture patterns involved Lateral Malleolus, Medial Malleolus, Bimalleolar, and Trimalleolar fractures. All participants went through clinical examination, preoperative imaging (CT and MRI), and intraoperative diagnostic methods to determine Syndesmosis integrity. Table 1 presents the characteristics of Syndesmosis damages patients. Figure 1 shows Characteristics of Syndesmosis damages patients (a) age and (b) gender.

| Demographic Variable | Category | Number of Patients (n = 100) | Percentage (%) |
|------------------------|-----------------------------|---------------------------------|-------------------|
| Age | 18-30 years | 25 | 25 |
| | 31-45 years | 30 | 30 |
| | 46-55 years | 20 | 20 |
| | 56-65 years | 25 | 25 |
| Gender | Male | 60 | 60 |
| | Female | 40 | 40 |
| Previous Ankle Surgery | Yes | 10 | 10 |
| | No | 90 | 90 |
| Smoking Status | Smoker | 20 | 20 |
| | Non-smoker | 80 | 80 |
| Alcohol Consumption | Yes | 50 | 50 |
| | No | 50 | 50 |
| Fracture Type | Lateral Malleolus | 50 | 50 |
| | Medial Malleolus | 20 | 20 |
| | Bimalleolar | 20 | 20 |
| | Trimalleolar | 10 | 10 |
| Body Mass Index (BMI) | Underweight (< 18,5) | 5 | 5 |
| | Normal weight (18,5 - 24,9) | 55 | 55 |
| | Overweight (25-29,9) | 30 | 30 |
| | Obese (≥ 30) | 10 | 10 |

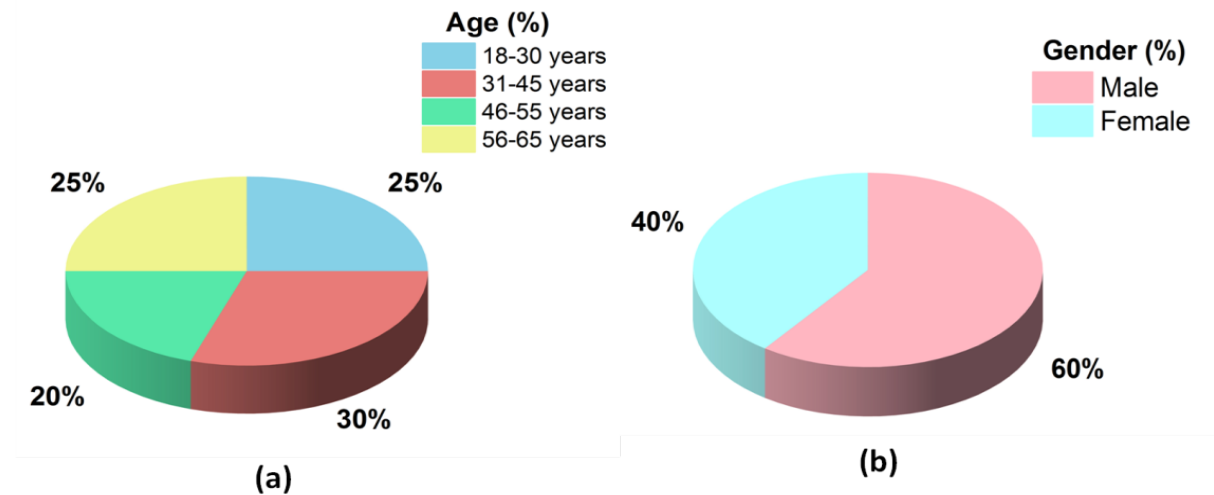


Figure 1. Presentation of patients' characteristics of (a) age and (b) gender

Diagnostic methods

The research assesses the efficacy of clinical assessment, preoperative imaging (MRI and CT), and intraoperative testing (stress tests and fluoroscopy) in diagnosing Syndesmosis injury in ankle fractures. Intraoperative findings, as validated by surgical exploration, yield the best diagnosis.

Clinical evaluation

The clinical evaluation is an important first step in the evaluation of patients with ankle fractures, especially those with possible Syndesmosis injuries. It starts with a thorough patient history, with emphasis on the mechanism of injury, the development of symptoms, and the quality of pain and swelling. The injured ankle for visible signs of deformity, tenderness, and swelling in range of motion is checked to see if there is any restriction, especially in dorsiflexion or rotation that could reflect instability or injury to the Syndesmosis. Pain in the lower leg or joint line is observed as it can indicate Syndesmosis ligament damage. Though revealing, this test usually necessitates additional imaging or intraoperative examination for definitive diagnosis.

Preoperative CT scan and MRI

Preoperative CT and MRI were used as non-surgical imaging modalities to evaluate Syndesmosis integrity in patients with ankle fractures due to external rotation. CT scans were used to yield high-resolution cross-sectional images that enabled the imaging of fractures, displacement, and possible Syndesmosis disruptions. This imaging modality was especially beneficial in the evaluation of bone fractures and detection of displacement in the tibiofibular Syndesmosis. MRI, however, provided better soft tissue resolution and allowed for the evaluation of ligament injuries, such as the Syndesmosis ligaments, that are frequently involved in external rotation fractures. Both modalities were employed preoperatively to evaluate the severity of the injury and plan the surgical procedure. Although useful, these tests were moderately sensitive for detecting subtle damage to the Syndesmosis when compared with intraoperative evaluations.

Intraoperative Testing

Intraoperative stress tests and fluoroscopy were employed to evaluate the Syndesmosis stability in real time. Stress tests entailed applying pressure or rotation to the ankle to monitor for any instability or abnormal movement of the Syndesmosis. Fluoroscopy allowed for live X-ray imaging, enabling the surgeon to observe joint alignment and identify any interruption of the Syndesmosis. Intraoperative diagnosis was confirmed by surgical exploration, allowing for direct visualization of the joint and verification of any injury to the Syndesmosis ligaments. This allowed for certain diagnosis and accurate evaluation and guided treatment during surgery.

Diagnostic Performance Metrics

Sensitivity, specificity, and accuracy were determined for each test by comparing the results of clinical examination, preoperative imaging, and intraoperative assessment. Surgical exploration was taken for diagnosing, thus allowing the performance of each method to be compared. The True Positives (TP), True Negatives (TN), False Positives (FP) and False Negatives (FN) performance metrics were also computed to examine each diagnostic strategy in detecting the occurrence of Syndesmosis injury and ascertaining which test was more consistent.

RESULTS

Sensitivity, specificity, and accuracy for both tests were estimated by comparing preoperative, intraoperative, and clinical assessments. Surgical exploration was used for facilitating performance metrics TP, TN, FP, FN, sensitivity, specificity and accuracy for assessing the capability of each of the diagnostic measures to identify injuries of Syndesmosis.

CT scan and stress test

Preoperative CT scans are instrumental in diagnosing Syndesmosis injury in ankle fracture patients. With the use of high-resolution cross-sectional imaging, CT scans allow one to visualize fractures in the bones, displacement, and even disruption of the Syndesmosis in cases of external rotation fractures. The finer pictures enable the clinician to evaluate the tibia and fibula alignment as well as associated fractures, like medial malleolus or bimalleolar fractures, which have a tendency to influence Syndesmosis stability. Although CT scans provide precise details of bone involvement, their diagnostic sensitivity for detecting soft tissue injuries, including ligament ruptures, is less compared to other modalities like MRI. The stress test is an intraoperative diagnostic method applied to assess the stability of the Syndesmosis during operation. During operation, the ankle joint is subjected to pressure or rotation and monitored for the reaction to observe abnormal movement or Syndesmosis instability. This test aids in the identification of subtle injury not seen in preoperative imaging. The stress test, in association with fluoroscopy, yields dynamic information on the stability of the joint so that precise decision-making in surgical treatment of Syndesmosis injury is made. Table 2 presents the diagnostic performance measures in CT scan and stress test. Figure 2 presents CT scan and stress test.

| Diagnostic Method | TN | TP | FN | FP | Sensitivity (%) | Accuracy (%) | Specificity (%) |
|----------------------------|----|----|----|----|-----------------|--------------|-----------------|
| Clinical Examination | 32 | 38 | 12 | 18 | 76,0 | 70,0 | 64,0 |
| Preoperative CT Scan | 30 | 44 | 18 | 8 | 71,0 | 74,0 | 78,9 |
| Intraoperative Stress Test | 39 | 51 | 4 | 6 | 92,7 | 90,0 | 86,7 |
| Combined CT + Stress Test | 42 | 53 | 2 | 3 | 96,4 | 95,0 | 93,3 |

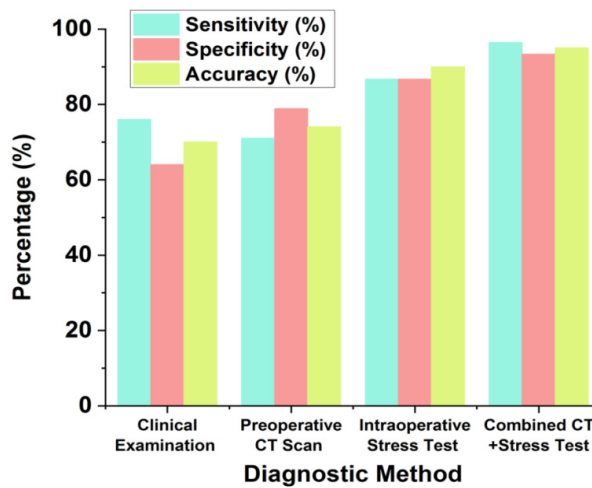


Figure 2. Presents CT scan and stress test

MRI & Fluoroscopy

MRI is a useful imaging modality for assessing soft tissue injuries, including ligament damage to Syndesmosis in ankle fracture. MRI gives high-resolution images of the soft tissues around the joint and can detect subtle tears or disruption of the ligaments that might not be detected with other imaging modalities. MRI is especially helpful with external rotation ankle fracture, where ligamentous injury is prevalent. Fluoroscopy is intraoperative employed to evaluate joint stability in real time. It gives real-time X-ray images, enabling surgeons to see the position of bones and the integrity of the syndesmosis during surgery. In combination with MRI, fluoroscopy increases diagnostic accuracy, allowing for more accurate surgical decisions and improved evaluation of syndesmosis injuries. The combination provides a complete strategy for identifying both bone and soft tissue involvement. Table 3 presents the diagnostic performance measures in MRI & Fluoroscopy. Figure 3 presents MRI & Fluoroscopy.

Table 3. Diagnostic performance measures in MRI & Fluoroscopy

| Diagnostic Method | TN | TP | FN | FP | Sensitivity (%) | Accuracy (%) | Specificity (%) |
|----------------------------|----|----|----|----|-----------------|--------------|-----------------|
| Clinical Examination | 28 | 42 | 10 | 20 | 80,8 | 70,0 | 58,3 |
| Preoperative CT Scan | 33 | 47 | 8 | 12 | 85,5 | 80,0 | 73,3 |
| Intraoperative Stress Test | 41 | 49 | 6 | 4 | 89,1 | 90,0 | 91,1 |
| Combined CT + Stress Test | 44 | 52 | 2 | 2 | 96,3 | 96,0 | 95,6 |

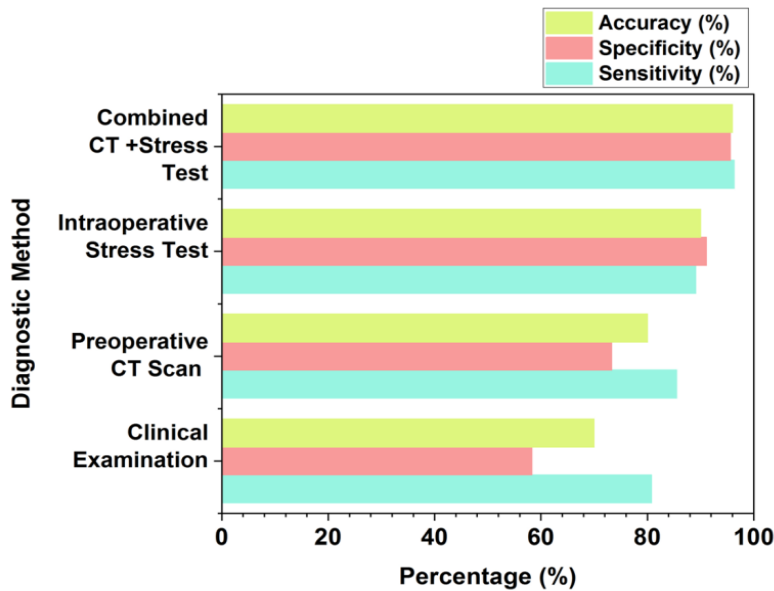


Figure 3. Graphical representation of MRI & Fluoroscopy

DISCUSSION

The management of these benefits is still up for disagreement. Numerous investigations demonstrate that the internal cavity of the ankle cannot effectively endure taller dislocation.⁽¹⁶⁾ Campbell and Hamilton showed that a taller movement of only one millimetre produced a forty-two percent decrease in the particular contacting area. Clinical investigation reinforces the accuracy of Syndesmosis elimination as a crucial element in generating positive therapeutic outcomes.⁽¹⁷⁾ The criteria for Syndesmosis fixation cannot be universally accepted. Syndesmosis injuries are often quiet and hard to diagnose. Physical examination techniques, especially the power source Cotton test and pressure test.⁽¹⁸⁾ Primarily efficient but inappropriate for an ankle that has just suffered an injury numerous static radiographic criteria have been discussed, including talocrural perspectives, tibia-fibular converge and radiographic empty regions.⁽¹⁹⁾ A different approach that is frequently encouraged though hardly utilized preceding surgery in acute ankle fractures, includes stress radiography. The latest research indicates that MRI and arthroscopy are more effective and reliable for predicting Syndesmosis injuries than static radiographs.⁽²⁰⁾ Based on readily recognizable fracture features, cadaver tests have tried to anticipate the requirement for Syndesmosis fixation.^(21,22) Whenever abnormalities occur when the ankle’s ligaments and bone tissue disintegrate one after another through the talus is forced to rotate in the mortise joint, these injuries have been found to affect Syndesmosis components and external rotation stability is maintained through the membrane between the bones, and midline tendons.⁽²³⁾ Physicians have depended on diagnostic radiography with biomechanical standards to assess Syndesmosis instability for SER and PER fractures. Ankle external rotation stress was analyzed both prior to and following medial malleolus fixation.⁽²⁴⁾ The ankle joint exhibits poor sensitivity regarding even slight movement. Smith and Jones demonstrated that Syndesmosis maledictions of only one and a half millimetres were clinically harmful. To define a positive stress evaluation, it used the low threshold of one millimetre of side-to-side variation. The treating surgeons were completely precise in their ability to identify this slight variation utilizing the fluoroscopic stress test during surgery, even though it can be impossible to judge the radiography parameters precisely at that time.⁽²⁵⁾ Although compared to standard radiography, the picture intensification makes it more challenging to recognize the Syndesmosis instability diagnostic criterion. It discovered that rotation impacted our capacity to determine the sizes of the radiography open areas accurately and overlapped. It evaluated the clinical effectiveness and practicality of intraoperative fluoroscopy to identify Syndesmosis instabilities in a progressive approach.^(26,27,28,29,30) Despite this, alternatives to therapy have constraints, and outcomes are typically poor whenever

rotational ankle fractures exhibit late Syndesmosis instability. Numerous Syndesmosis injuries occurred in this investigation for fractures that can have been treated differently by bimalleolar fixation after early mobility and weight-bearing and without Syndesmosis stabilization.^(31,32,33)

CONCLUSIONS

Intraoperative evaluation, especially through the application of stress tests and fluoroscopy, was found to be the best diagnostic approach to Syndesmosis injuries among patients with external rotation ankle fractures. The outcome showed excellent sensitivity (92,7 %) and specificity (86,7 %) in detecting minute Syndesmosis disruption superior to preoperative imaging and physical examination. Although CT scanning and MRI gave useful information about bone breaks and soft tissue integrity, it revealed moderate sensitivity in revealing subtle Syndesmosis injury to intraoperative assessment. Clinical examination, although beneficial, was less successful in the detection of occult Syndesmosis injury. Intraoperative diagnostic methods, the research suggests, play a key role in refining diagnostic accuracy and surgical decision-making and, in the long run, improving outcomes for patients. More studies are needed to further develop diagnostic protocols and incorporate these results into clinical practice for improved management of ankle fractures with Syndesmosis injury.

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ANNEXES

| Acronyms | Description |
|-----------------|---|
| EGC | Early Gastric Cancer |
| ER | Endoscopic Resection |
| EUS | Endoscopic Ultrasound |
| CRC | Colorectal Cancer |
| CP | Colorectal Polyps |
| CRC | Colorectal Cancer |
| AITFL | Anterior Inferior Tibiofibular Ligament |
| IOL | Intraocular Lens |
| AAI | Anterior Ankle Inflammation |
| TP | True Positive |
| TN | True Negative |
| FP | False Positive |
| FN | False Negative |
| CT | Computed Tomography Scan |
| SER | Supination-External Rotation |
| PER | Pronation-External Rotation |