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ORIGINAL ARTICLE

Is there any change in surgeon's attitude to the management of ankle fractures accompanying syndesmotic injury? A nationwide survey

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ABSTRACT

Objectives: This study aims to investigate the attitudes of orthopedic surgeons to the management of ankle fractures accompanied by syndesmotic injury with a nationwide survey.

Patients and methods: In the first step of this descriptive study, an electronic survey was prepared in Google drive and a survey link was sent to the Turk-Ortopedi e-mail group between 09 and 19 January 2019. The orthopedic surgeons and residents were requested to complete the questionnaire. A total of 320 orthopedic surgeons (77%) and residents (23%) participated in the survey. The responses were analyzed statistically. To evaluate the changing attitudes, our results were compared with the surgeon survey studies key worded "syndesmotic injury" in PubMed.

Results: The majority of the participants stated that they used the hook test, external rotation stress test, and fluoroscopy together (47.2%) for the diagnosis of syndesmotic injury during the operation. Of the participants, the majority (93%) reported to use metallic syndesmotic screws, and 59% reported to remove the syndesmotic screw routinely. Young surgeons with five to 10 years of experience preferred intraoperative diagnosis methods compared to surgeons with more than 20 years of experience. Foot and ankle surgeons and sports surgeons reported to allow weight bearing before removal of the screw much more than other unspecified branches.

Conclusion: The preferences of the surgeon vary in syndesmotic injuries and there is still no consensus regarding diagnosis and rehabilitation. Compared to the past decade, fewer surgeons prefer to remove the screws today.

Keywords: Ankle fracture, surgeon preference, survey, syndesmotic injury.

Ankle fractures accompanied by syndesmotic injury are common traumas in orthopedic practice. The mechanism of these injuries has been clearly described.[1] There is a consensus that diastasis in syndesmosis should be reduced and, if not, it may result in severe ankle arthrosis.[2] However, there is no consensus on the management of ankle fractures accompanying syndesmotic injury.[3-6] Although syndesmotic screw fixation after reduction is widely accepted as the gold standard treatment, a consensus has not yet been reached in the literature about the details of the screw fixation.[3] There is also disagreement about rehabilitation after treatment.[7] Various studies continue to search for solutions to these controversial issues; however, surgeons prefer to use the methods which they are familiar with because of the lack of evidence.[8,9]

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Although there were several survey studies all over the world, there is no study determining the trends and attitudes of Turkish Orthopedic surgeons to the management of this particular type of injury. Besides, there is no comparison of surveys in the last decade determining current surgeon attitudes according to

changing evidence. Therefore, in this study, we aimed to investigate the attitudes of orthopedic surgeons to the management of ankle fractures accompanied by syndesmotic injury with a nationwide survey.

PATIENTS AND METHODS

This descriptive study was conducted at the Dışkapı Training and Research Hospital. Controversial issues regarding the treatment of ankle fractures accompanied by syndesmotic injury were determined by reviewing recent meta-analyses and reviews on this topic.[3-5] We performed a comprehensive PubMed search regarding surgeon surveys with the keywords "syndesmotic injury". Controversial issues were compared with these surveys from other countries.[8-17] The debatable topics on the diagnosis, treatment, and follow-up of ankle fractures accompanied by a syndesmotic injury were determined and a questionnaire was prepared. The survey consisted of 16 questions in four sections: surgeon characteristics (4 questions), syndesmotic injury diagnosis strategy (2 questions), treatment strategy (7 questions), and postoperative follow-up (3 questions) (Table I). The study protocol was approved by the Dışkapı Training and Research Hospital Institutional Review Board (07.01.2019-58/12). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The questionnaire was checked by three orthopedic surgeons with at least 10 years of orthopedic surgery experience and three orthopedic residents to test the content of the questionnaire and the use of common terminology and ease of application in various experience groups.

The final survey was prepared in a multiple-choice form in the Google drive. The survey was sent three times between 09 and 19 January 2019 to the Turk-Ortopedi e-mail group which is an electronic mail group to which the majority of Turkish orthopedic surgeons are subscribed. The orthopedic surgeons and residents were informed and requested to complete the questionnaire. There were approximately 5,000 orthopedic surgeons and residents serving in Turkey at the time of survey completion. The ideal sample size was found to be between 253 to 357 correspondents with a 95% confidence interval and a 5-6% margin of error. Data collection was stopped after the achievement of 323 correspondents. Thus a total of 323 orthopedic surgeons and residents participated in the survey. Three improperly completed questionnaires were excluded and finally 320 were included.

Statistical analysis

Statistical analysis of the data obtained from the survey was performed using the IBM SPSS for Windows version 20.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics for categorical variables were presented as numbers and percentages. In the group comparisons, chi-square test statistics were used when the chi-square condition was satisfied, and Fisher's exact test was used when the condition was not provided. To determine from which group the difference originated for significant tests, the percentages of columns in the groups were compared and significant differences were determined with Bonferroni correction. A value of $p<0.05$ was considered statistically significant.

RESULTS

Of the 320 records, 75 (23.4%) were from residents and 245 (76.6%) from surgeons. The majority of all participants (60.7%) contributed from an academic institution such as university or training and research hospital. Surgical experience was recorded as five to 10 years by 26.9%, and >10 years by 50%. Most of the residents (73.3%) participating in the study consisted of senior residents (Table I).

The majority of the participants stated that they used the hook test, external rotation stress test, and fluoroscopy together (47.2%) for the diagnosis of syndesmotic injury during the operation. Details regarding diagnosis are given in Table I.

Most of the surgeons (92.8%) who decided to use syndesmotic fixation stated that they used metallic syndesmotic screws, and 5.6% used suture fixation device (SFD) (Table I). None of the foot and ankle surgeons used SFD. Four percent of the general orthopedic surgeons, 9.6% of sports surgeons, and 8.8% of trauma surgeons stated that they used SFD instead of a syndesmotic screw.

The majority of the respondents (57.9%) stated that they allowed weight bearing without removing the syndesmotic screw, and 58.8% stated that they routinely removed the syndesmotic screw. Of the surgeons who removed the screws, the majority (56.8%) stated that they removed the screws in the first eight weeks, while 31.9% stated that they waited 12 weeks or more. Results regarding postoperative management are given in Tables I and II.

The results of the analysis showed that young surgeons with 5 to 10 years of experience significantly preferred intraoperative diagnosis methods compared to surgeons with more than 20 years of experience

TABLE I
Questions and responses of survey (n=320)

	n	%		n	%
Institution			Number of cortices fixed with syndesmosis screw		
Private Hospital	55	17.2	3 Cortices	212	67.3
State Hospital	63	19.7	4 Cortices	102	32.4
Training and Research Hospital	125	39.1	Other	1	0.3
University Hospital	69	21.6			
Private Practice	8	2.5			
Title			Method of syndesmosis reduction in surgery		
Faculty member	80	25	Squeezing with hand	148	46.3
Surgeon	165	51.6	Squeezing with clamp	139	43.4
Resident	75	23.4	Other	33	10.3
Experience in orthopedics (including residency period), (year)			Ankle position when placing syndesmosis screw		
			Maximum dorsiflexion	110	34.4
0-2	19	5.9	Neutral	121	37.8
2-5	55	17.2	Zero degree dorsiflexion	82	25.6
5-10	86	26.9	Other	7	2.2
10-15	61	19.1			
15-20	40	12.5			
Over 20	59	18.4			
Special interest (subspecialty)			Level of syndesmosis screw (distance from joint level)		
General orthopedics	100	31.3	0-2 cm	46	14.4
Foot and ankle surgery	13	4.1	2-4 cm	248	77.5
Trauma	102	31.9	Above 4 cm (supra syndesmotic level)	20	6.3
Sports	62	19.4	From the empty hole on the plate	6	1.9
Other	43	13.4			
Diagnosis method of syndesmotic injury			Routine repair of deltoid ligament in patients with diastasis		
Plain radiographies	110	34.4			
Stress radiographies	102	31.9	No	233	72.8
Intraoperative methods	90	28.1	Yes	87	27.2
Other	18	5.6			
Confirmation method of syndesmotic injury during surgery	70	21.9	Allowing weight bearing without removing the syndesmosis screw		
Hook test	43	13.4	No	184	57.9
Fluoroscopy with external rotation stress	151	47.2	Yes	134	42.1
Both methods	50	15.6			
I decide before surgery	6	1.9			
Other					
Syndesmotic fixation method preference used in ankle fracture	296	92.8	Routine removal of the syndesmosis screw		
Metallic syndesmotic screw	21	5.6	No	187	58.8
Suture button	2	0.6	Yes	131	41.2
Bioabsorbable screw					
Diameter preference while using screws			Removal time of the syndesmosis screw (weeks after operation)		
3.5 mm	216	68.6			
4.5 mm	93	29.5	6^{th} week	68	25.9
Other	6	1.9	8^{th} week	83	32.3
			12^{th} week	72	28.3
			Later	10	3.9
			Other	24	9.3

($p<0.05$). The least experienced residents stated that they often allowed weight bearing without screw removal and fixed the syndesmosis in neutral position ($p<0.05$). The statistically significant details regarding the experience are given in Table II.

Physicians interested in hand surgery, spine, arthroplasty and tumor were defined as other fields and participated in the survey at the rate of 13.4%. Although syndesmotic injury is frequently encountered by every specialist in orthopedic surgery, it is more of a concern for general orthopedics, trauma surgery, sports surgery, and foot surgery. The rate of participants involved in these four branches was 86.7% (Table I).

There was no significant difference found between the results except in respect of screw diameter and weight-bearing recommendation of subspecialists. The screw diameter preference of 3.5 mm was

TABLE II

Statistically significant responses regarding surgeon's experience and subspecialty

		Experience												
		0-2 years		2-5 years		5-10 years		10-15 years		15-20 years		20 years and more		
Group	Subgroup	n	%	n	%	n	%	n	%	n	%	n	%	*p*
Diagnosis	Plain radiographs	5	27.8	14	25.5	25	31.2	25	41.0	13	38.2	28	51.9	
	Stress radiographs	8	44.4	27	49.1	21	6.2	19	31.1	10	29.4	17	31.5	0.022
	Intraoperative methods	5	27.8	14	25.5	34	42.5**	17	27.9	11	32.4	9	16.7*	
Position of the ankle	Neutral	14	73.7**	24	45.3	24	28.6*	20	32.8*	12	31.6*	27	46.6	
	Maximum dorsiflexion	2	10.5	18	34.0	31	36.9	20	32.8	17	44.7	22	37.9	0.01
	0 degree dorsiflexion	3	15.8	11	20.8	29	34.5	21	34.4	9	23.7	9	15.5	
Weight-bearing	No	2	10.5	23	41.8	41	47.7	19	31.1	19	47.5	30	50.8	0.014
	Yes	17	89.5**	32	58.2	45	52.3*	42	68.9	21	52.5	29	49.2*	

		Subspecialty										
		Foot/ankle		Gen Orth		Sports		Trauma		Other		
Group	Subgroup	n	%	n	%	n	%	n	%	n	%	*p*
Screw diameter	3.5 mm	10	76.9	68	68.0	38	66.7	83	82.2**	22	51.2*	0.004
	4.5 mm	3	23.1	32	32.0	19	33.3	18	17.8*	21	48.8**	
Weight bearing	No	3	23.1	51	51.0	19	30.6	36	35.3	25	58.1	0.005
	Yes	10	76.9**	49	49.0	43	69.4**	66	64.7	18	41.9*	

Gen Orth: General Orthopedics; There is a statistical significance between parameters indicated with a single asterisk and parameters indicated with double asterisks on same line.

reported by 82.2% of trauma surgeons, which was higher than the responses of other subbranches ($p<0.05$). The surgeons who used the 4.5 mm screw most were the surgeons in other unspecified areas. Foot and ankle surgeons and sports surgeons tended to allow weight bearing before removal of the screw much more than other unspecified branches ($p<0.05$) (Table II).

DISCUSSION

In this study, we found that there is no consensus on the majority of the questions regarding the diagnosis and follow-up of ankle fractures accompanied by syndesmotic injury. Regarding the treatment, there seems to be a consensus on three cortices fixation of 3.5 mm, metallic screw from 2-4 cm distance from the joint without the repair of deltoid ligament. However, there was no consensus regarding syndesmosis reduction technique and ankle position during screw fixation. When compared with the literature, routine screw removal rate was the only changing attitude of surgeons during the last decade.[18]

The survey was delivered within an e-mail group which is the most widely used e-mail network (which had 2,180 members at the time of delivery) by orthopedic surgeons in Turkey. A total of 320 valid questionnaires were completed, with a participation rate of approximately 15%. The average participation rate in studies investigating surgeon preferences for ankle injuries since 2008 is approximately 28%.[8-17] More participants were reached than the average[8-17] although the participation rate seems low. In addition, there was participation from a wide range of experience from residents to faculty members. This study is one of the few studies in the literature to include respondents from almost every working environment such as universities or teaching hospitals etc. The study principles of the current and previous studies are given in Table III.

There is no consensus on the preoperative diagnosis of syndesmotic injury. More than two-thirds of the respondents stated that they performed imaging in addition to standard conventional radiographs. This rate was similar to those of UK and Netherland studies (Table IV).[8,9] While conventional radiographs were used most frequently before 2010 in the diagnosis of syndesmotic injuries, the preference for the use of stress radiographs has increased since then.[11,16] There is a rising demand for stress radiographs and less use of conventional radiographs in the current study (Table IV).[8-12,16] Although the decision of syndesmotic stability can be safely established with advanced radiological imaging studies such as ultrasound, computed tomography, and magnetic resonance imaging,[19,20] very few of the respondents reported using them.

Almost half of the respondents stated that they used the hook test, external rotation stress test, and fluoroscopy together during the operation. The combined use of the hook test and other intraoperative methods was similar to the findings of previous studies.[8-12,16] However, these results showed that Turkish orthopedic surgeons do not rely on the hook test alone as much as surgeons in the Netherlands.[9] Another interesting finding from the current survey was that 15.6% of the participants stated that they had already decided before surgery whether or not they would perform syndesmotic fixation. These surgeons might be those who decide on the management plan according to the injury mechanism.

The majority of the participants (92.8%) stated that they use metallic screws for syndesmotic injuries while 6% used SFD. The predominance of metallic screw use was consistent with previous studies (Table IV). However, SFD has been shown to provide adequate fixation in cadaveric and clinical studies, and there are also publications indicating better functional results than screws.[21] The major disadvantage of using SFD is its cost and low availability compared with screws and is probably the reason for its limited use in this survey. Although the cost of SFD is higher than screws, when secondary procedures for device removal are considered, the cost for dynamic fixation has been found to be lower.[22]

Although 3.5 mm screws are more frequently broken than 4.5 mm screws, both screw sizes provide sufficient stability, while the size of the screw is still debatable.[8] In the current study, 3.5 mm screws were the most preferred size, although this rate was a little lower than that reported in the study by Schepers et al.[9] Consistent with previous survey studies, Turkish orthopedic surgeons still prefer 3.5 mm screws over 4.5 mm screws (Table IV).

Biomechanically and clinically, there is no significant difference between three- and four-cortex fixations. The advantage of four-cortex screws seems to be that they are easier to remove in case of breakage while three-cortex screws have the advantage of allowing some physiological movement.[23] In this study, 67% of the participants stated that they preferred three-cortex fixation while 32% preferred four-cortex fixation. This rate is consistent with previous survey studies except for the findings of Bava et al.[8] The current study also showed that the choice of the

TABLE III

Demographic data and topics of previous survey studies regarding syndesmotic injuries

Study/country	Survey type	Correspondents	Number of respondents	Response rate (%)	Surg subspecialties	Experience	Injury type/topic
Wood and Feldman[10] UK	Postal	Orth surg practicing in two different regions in UK	124	54	NA	NA	Weber type C Fx
Monga et al.[11] UK	Postal	Orth surg practicing in two different regions in UK	189	61	NA	NA	Ankle injuries with syndesmosis disruption
Bava et al.[8] US	E-mail	Trauma and F&A fellowship directors and member from (OTA) and (AOFAS)	77	50	F&A (59%) Trauma (28%) Other (4%)	>10 year (71%) <10 year (29%)	Weber-C Fx
Ansari et al.[13] AU	Online/e-mail	Member of (AOA)	358	47	Trauma (43%) Arthroscopy (34%), General (29%), Sports (25%) F&A (19%) & Other	>16 year (41%) 0 to 5 year (23%) 6 to 10 year (20%) 11-15 year (16%)	Five common Fx including minimally displaced AO Type B Fx of the lateral malleolus (others scaphoid, distal radius, neck of humerus, and clavicle)
Gardner et al.[14] US	Online/e-mail	Member of (OTA) & (AOFAS)	401	20	Trauma (24%) F&A (50%) no or Other (24%)	>10 year (64%)	Posterior malleol Fx
Kołodziej et al.[12] PL	Distribution in congress	Participants of the 3rd congress of the polish F&A society	54	63	Orthopedists	NA	Weber type B Fx with syndesmotic disruption
Schepers et al.[9] NL	Postal	Trauma and orthopedic surgeon in 86 hospitals in the NL	147	74	Trauma (57.8%) General (42.1%)	<5 year (24.6%) 6-15 year (38.2%) >15 year (37.2%)	Weber-B ankle fracture and Maison-neuve injuries
Swart et al.[15] US	Online/e-mail	Member of (AOFAS) & (OTA)	702	31	F&A (65.8%), Trauma (34.1%	NA	Non-weight-bearing protocol after ankle Fx fixation
González-Lucena et al.[16] ES	Online/e-mail	Orthopedic surgeon in 7 hospital centers in Spain & member of F&A group of Barcelona	72	24	Trauma (48.6%) F&A (51.4%)	Mean of 13 year	Five different ankle Fx types and syndesmosis injury
Van Leeuwen et al.[17] NL	Online/e-mail	Trauma surgeon from NL	161	32	Trauma	NA	Weber type B Fx
Atilla et al. 2020 TR	Online/e-mail group	Member of the Turk-Ortopedi email group	320	15	Trauma (31.9%), General (31.3%), Sports (19.4%), F&A (4.1%), Other (13.4%)	0-5 year resident (23.1%) 0-10 year (46%) >10 year (30.9%)	Ankle Fx with syndesmosis injury

NL: Netherlands; ES: Spain; AU: Australia; PL: Poland; TR: Turkey; US: United States of America; GB: Great Britain; NA: Non available; Fx: Fracture; F&A: Foot and Ankle; OTA: Orthopaedic Trauma Association; AOFAS: American Orthopaedic Foot and Ankle Society; AOA: Australian Orthopaedic Association; AO: Arbeitsgemeinschaft für Osteosynthesefragen; N of respo: Number of respondents; Orth: Orthopedic; RR: Response rate; Surg: Surgeon.

TABLE IV
Management preferences of surgeons in previous survey studies

	Diagnosis			Treatment			Postoperative		
	Preoperative diagnosis (%)	Diagnosis confirmation in surgery (%)	Syndesmotic fixation (%)	Screw diameter 3.5/4.5 mm (%)	Cortices engaged 3/4 (%)	Placement level of the screw	Routine removal (%)	Timing removal <8 weeks	Timing removal more than 8 weeks (%)
Wood and Feldman[10]	NA	NA	Screw 30	51/42	60/37	NA	92	77%	23%
Monga et al.[11]	X-ray 18	NA	Screw 97	50/32	59/34	2-4 cm 56% >4 cm 25%	84	NA	NA
Bava et al.[8]	NA	NA	Screw 92	51/24	29/67	NA	65	NA	3 m 49% 4 m 37% 6 m 12%
Kołodziej et al.[12]	X-ray 37	NA	Screw 81	NA	NA	NA	NA	NA	NA
Schepers et al.[9]	X-rays 87%	Hook test 50 Exorot stress 9 Both 36	Screw 90 Other 6	86/11	64/31	0-2 cm 5% 2.1-4.0 cm 76% 4.1-6.0 cm 16%	87	6-8 w 74%	8-10 w 18% 10-12 w 4%
González-Lucena et al.[16]	X-rays 80 stress X-rays 17	NA	Screw 96 Flexible systems 4	NA	75/21	71/72 screws above syndesmosis	86.1	6 w 53%	12 w 39% 12 w and more 8%
Atilla et al. 2020	X-rays 34 stress X-rays 32 intraoperative Methods 28 Other 6	Hook test 22 Fluoroscopy with exorot stress 13 Both 47 Decide before surgery 16	Screw 93 Flexible systems 6 Bioabsorbable 1	69/30	67/32	0-2 cm 14% 2-4 cm 78% >4 cm 6% From the empty hole on the plate 2	59	8 w 58%	8 w or more 42%

NA: Non-available; Exorot: External rotation; m: Month; w: Weeks.

number of cortices to be fixed does not change with surgical experience or subspecialty.

The position of the screw and the position of the ankle during screw insertion are also controversial. The majority of participants in the current study preferred 2 to 4 cm proximal to the tibial plafond. Although the debate about the ideal location of the screw continues, 2 to 4 cm proximal to the joint seems to be the most appropriate site in the literature.[24] Olerud[25] stated that over-compression of syndesmosis would limit neutral range of motion, and this statement has led surgeons to fix the syndesmosis when the ankle is in maximum dorsiflexion. However, in later cadaver studies, it was shown that ankle position during fixation did not affect motion.[26] Orthopedic surgeons are still confused between the previous and relatively new evidences.

Postoperative malreduction is common in such injuries and the reduction of syndesmosis is one of the most important indicators of good functional outcomes.[27] Reduction of syndesmosis with the aid of a clamp has been previously reported to be a risk factor for postoperative malreduction.[28] Instead of a wide clamp, reduction of syndesmosis by using hands and temporary Kirschner wire fixation reduces the malreduction rate.[28] In the current study, reduction with a wide clamp was preferred at the rate of 43.4%, and the rate of manual reduction was 46.3%, which was higher than the findings of the study by Schepers et al.[9] The rate of participants using methods other than these two responses was similar at 10.3%. It seems that methods that are risky for syndesmotic malreduction are still commonly used.

The currently available literature does not support routine elective removal of syndesmotic screws.[29] The removal of syndesmotic screws is advisable mainly in cases of patient complaints related to the other implanted perimalleolar hardware or malreduction of the syndesmosis after at least eight weeks postoperatively.[30] In the current study, 58.8% of the respondents reported routine removal of the syndesmotic screw. This is the lowest rate in the survey literature, and over the years, this is one of the most dramatically changed surgeon preferences in ankle fracture management surveys. However, 58% of the respondents in the current study reported that if they remove the screw, it would be within eight weeks. Although this rate is high, Schepers et al.[9] reported a higher rate of 73.9% in 2012 (Table IV).

Surgeons with 10 years and less experience used intraoperative methods more than surgeons with 20 years or more experience. Although it has been known for many years that direct radiographs alone may be insufficient for the diagnosis of this injury, even experienced surgeons reported to establish decision by plain radiographs.[20] González-Lucena et al.[16] investigated whether foot surgeons have a different perspective for these injuries compared to general orthopedists and concluded that foot surgeons used more diagnostic tests, applied more diverse surgical techniques, and had lower revision rates. The majority of trauma, sports and foot surgeons allowed weight bearing without removing the trans-fixation screw. Orthopedic subbranches that frequently encounter ankle fractures in daily practice are more likely to risk the breakage of the screw when treating syndesmotic injuries by using a thinner screw and allowing weight bearing, and thus it can be said that other subbranches are more conservative in this regard.

There are several limitations of this study. The low response rate of this survey seems as a limitation, while the number of participants was one of the highest compared to similar surveys. Participation rate can be low if the source is a large general e-mail group rather than a directly postal or electronic mail touch. Nevertheless, by using the mail groups as data source, response rate can be low, while participation number increases. On the other hand, the survey was not questioned in respect of case samples; therefore, the medical status, age, and bone quality of patients could not be investigated. Lastly, there are no established fellowship education programs except hand and spine surgery in Turkey; consequently, the subspecialties of the surgeons can be accepted as the special interest or self-practice of the surgeons.

In conclusion, the preferences of surgeons still vary particularly in the diagnosis and rehabilitation of syndesmotic injuries. The dominant preference of using metallic screws is still persistent despite the reported better outcomes of SFDs. In treatment, surgeons have not reached an agreement upon the reduction technique or ankle position during screw placement. The rate of routine screw removal was the lowest compared to the similar surveys and this was the only changing attitude of surgeons in the last decade which was consistent with the recent scientific evidence. Since there are still many debatable issues and practices conflicting with the evidence, it would be beneficial to establish management guidelines for ankle fractures accompanying syndesmotic injuries.

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