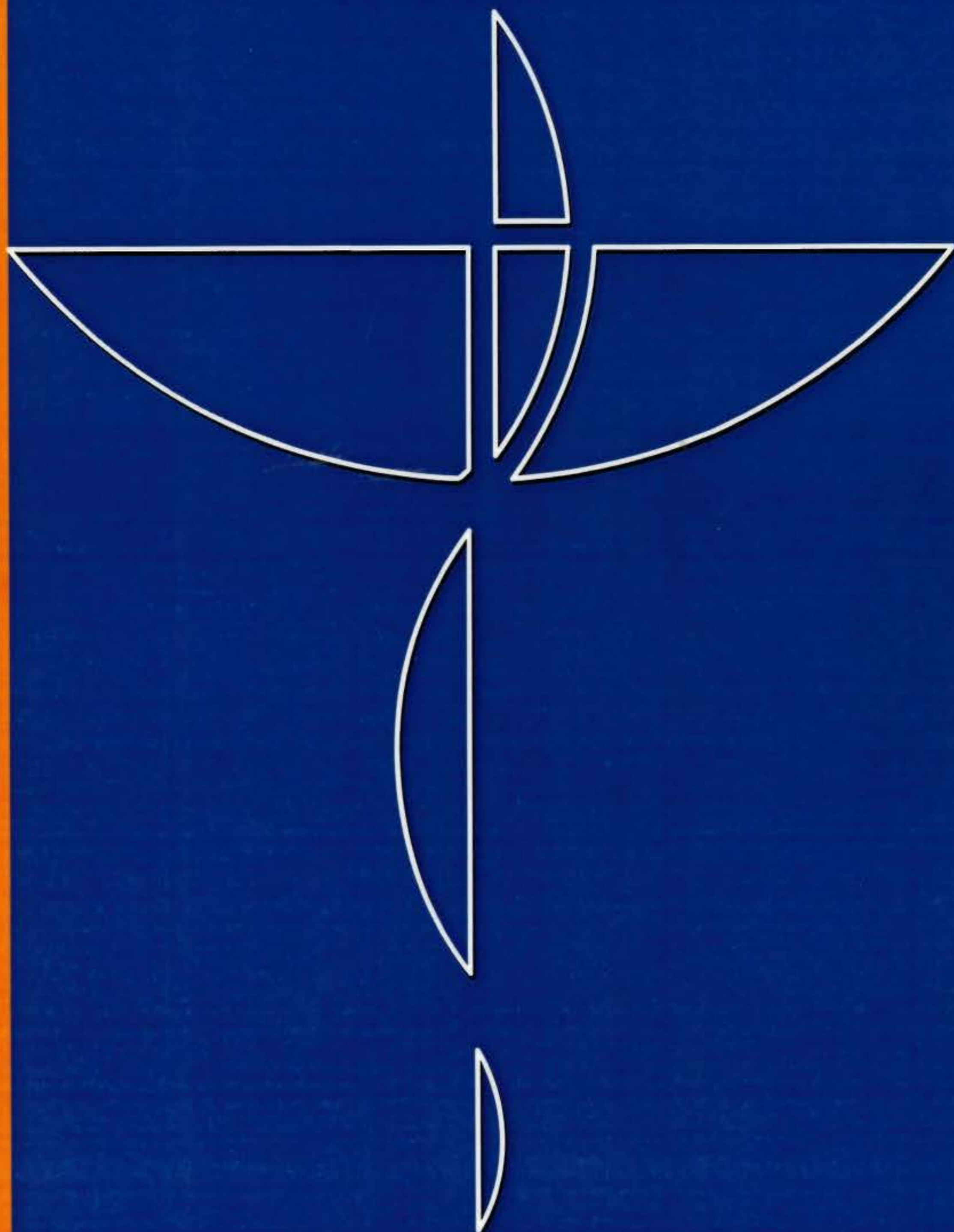


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## SYNDESMOSIS TRANSFIXATION – EFFECT ON THE FUNCTIONAL OUTCOME

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### Abstract

**Introduction** Ankle fractures represent the most common injury to the lower limb, and their incidence has been consistently increasing during the past decades. The aim of the present study was to evaluate the effect of the level of syndesmotic transfixation in Weber type B and C ankle fractures with syndesmotic disruption on the functional outcome a year post injury.

**Materials and Methods** A prospective study was conducted at the authors' institution in a two year-period. Demographics, injury pattern and type of surgery were recorded. Functional outcome was evaluated using the American Orthopedic Foot and Ankle Society Score one year post surgery. The results were analyzed with descriptive and non-parametric tests.

**Results** The study included a total of 57 patients with no gender predominance and mean age of 45 years. Most of the examinees sustained the injury by low-energy trauma; however, there was no predominance of B or C fracture types. The best functional scores a year post injury was noted in a group in which screw was placed in an interval 21-40 mm above the tibial plafond (mean of 88 points). Those in whom the screw was placed above or below this interval had lower scores; however, the difference was not statistically significant.

**Conclusion** The level of syndesmotic transfixation does not have an effect on the functional outcome. However, the patients with a screw placed in the interval 21-40 mm above the tibial plafond have the most favorable functional scores.

**Keywords:** ankle, fracture, syndesmosis, level, outcome, transfixation

## ВЛИЈАНИЕ НА НИВОТО НА ФИКСАЦИЈА НА СИНДЕЗМОЗАТА НА СКОЧНИОТ ЗГЛОБ ВРЗ ФУНКЦИОНАЛНИОТ ИСХОД КАЈ ПАЦИЕНТИТЕ СО МАЛЕОЛАРНИ ФРАКТУРИ

### Апстракт

**Вовед** Фрактурите на скочниот зглоб се најчеста повреда на долниот екстремитет и нивната инциденција расте во тек на последните децении. Целта на презентирното истражување беше да се евалуира ефектот на нивото на фиксација на синдезмосата врз функционалниот исход кај Вебер В и С фрактурите една година по повредата.

**Материјал и методи** Истражувањето се спроведе во тек на две години. Ги регистриравме демографските карактеристики, карактеристиките на повредата и операцијата и функционалниот исход според скалата на Американското здружение за

ортопедија и трауматологија една година по повредата. Резултатите се анализираа со дескриптивни и непараметраски методи.

**Резултати** Студијата вклучи 57 пациенти со рамномерна полова дистрибуција и средна возраст од 45 години. Предоминираше нискоенергетска повреда. Најдобар функционален исход беше регистриран кај испитаниците со фиксација на ниво 21-40 милиметри од тибискиот плафон (средно 88 поени). Оние кај кои фиксацијата беше на ниво под и над споменатото ниво има понизок скор, но без статистичка сигнификантност.

**Заклучок** Нивото на трансфиксација на синдесмозата нема влијание врз функционалниот исход една година по повредата. Резултатот е најповолен кај оние пациенти со фиксација во интервалот 21-40 милиметри на тибискиот плафон.

**Клучни зборови:** скочен зглоб, фрактура, синдесмоза, исход, ниво, трансфиксација

## Introduction

Despite changes in the incidence of several fracture types in the past decades, ankle fractures have remained the most common skeletal injury of the lower limb [1]. At the same time, these injuries represent the most frequent articular fracture to the weight-bearing joint in humans [2]. Since great proportion of ankle fractures are addressed surgically, many surgeons consider themselves quite competent in treating these injuries, and even more, ankle fractures are widely regarded as trainee surgery worldwide [3].

Nevertheless, several studies have reported unfavorable long-term outcomes of the operative treatment of ankle fractures [4]. Although significant changes in the management of these injuries should not be underestimated, and the understanding of these injuries has improved, it is a matter of fact that complications remain and controversies still occur [5].

Currently, a significant scientific work is focused on several subjects in the treatment of these injuries: which fractures should be addressed with open reduction and internal fixation, the need for stabilization of the posterior malleolus, treatment modalities and decision making on syndesmotic transfixation and fibular nailing representing the top hot topics [6].

However, it seems that syndesmotic injury has gained the reputation of the cornerstone in achieving good functional outcome. This component of the ankle fractures is present in up to one-fourth of those suffering ankle fractures [7,8,9,10,11,12]. While metallic screw is still considered the gold standard for syndesmotic transfixations, several technical aspects of syndesmotic transfixation are widely debatable: duration of the syndesmotic transfixation, level of screw placement, number of screws, number of cortices engaged. [12,13,14,15,16].

The aim of the present study was to evaluate the functional results following syndesmotic transfixation with regard to the level of screw placement in patients who had been surgically treated for bimalleolar fracture in a single institution.

## Materials and Methods

The present study was conducted at the University Clinic of Traumatology - Medical Faculty of Skopje, in a two-year-period (January 2016 – January 2018). It was designed as a prospective longitudinal research focused on the functional results of patients with bimalleolar fracture accompanied with intraoperatively verified syndesmotic disruption that was reduced and fixed with a single screw in a three cortical manner. Inclusion was limited

to those older than 17 years, while exclusion criteria were defined as follows: postoperative deep surgical infection, nonanatomical reduction of the malleolar fractures [17], fracture of the posterior malleolus present, nonanatomical reduction of the syndesmosis [18,19] open fracture, implant failure prior to bone healing, other injury (skeletal or visceral) caused at the same time as ankle fracture that was addressed surgically, any postoperative complication related to the ankle fracture requiring additional surgery-revision (unacceptable reduction of the malleoli or syndesmosis, screw in the joint, deep surgical site infection requiring implant removal), poor general condition (ASA score more than 3) [20].

All patients were treated within the first 12 hours following the injury. The surgical procedure was undertaken by a senior surgeon in accordance with the AO principles [19]. Fibula was approached by a straight lateral incision and following reduction, fixation was performed with one-third tubular plate, while medial malleolar fracture was reduced by direct visualization and fixed with one or two 4.0 mm cancellous lag screws. Following malleolar fixation, syndesmotic integrity was tested using hook test under fluoroscopic control [21]. If present, syndesmotic lesion was transfixed with a positioning 3.5 mm cortical screw in a three cortical manner through the plate hole. The screw was tightened at full dorsiflexion of the foot. The procedure was undertaken under fluoroscopic control. Postoperatively, splint was applied for two weeks while soft tissue swelling subsided and stitches were removed. Partial weight bearing was advised 4 weeks post surgery, while full weight bearing 1.5 months post surgery. Thromboprophylaxis was given for 4 weeks. Single antibiotic prophylaxis was administered 30 minutes prior to surgery.

Demographics, mechanism of injury, fracture type according to Denis-Weber classification [22] and level of syndesmotic screw placement were determined on the initial and early postoperative X-rays. The patients that met the inclusion and exclusion criteria were informed about the nature and purpose of the study, and they signed the informed consent if they wished so. They were also informed that they can leave the study anytime by their own will or that they can be excluded, based on the exclusion criteria.

Functional outcome was evaluated on a final follow up – one year post surgery. For this purpose, the American Orthopedic Foot and Ankle Society Score (AOFAS) was used. The score consists of nine questions with the best possible score of 100 points. The questions related to the alignment and range of motion were completed by the examiner.

All the collected data were recorded in a database (Microsoft Excel). Regarding the level of syndesmotic transfixation on an early postoperative x-rays, the whole study group was divided into three groups as follows: group A (the positioning screw at the level of  $\leq 20$  mm measured from the tibial plafond); group B (the positioning screw at the level of 21-40 mm measured from the tibial plafond) and group C (the positioning screw at the level of  $>40$  mm measured from the tibial plafond). Following completion, the data were transferred to statistical software (SPSS, version 18.0). The analysis was made by descriptive statistics (mean, median, standard deviation, percentage); Kruskal-Wallis H test was used to compare the distributions of the defined groups of examinees. Statistical significance was defined as a p value  $<0.05$ .

## **Results**

The present study included a total of 57 patients. Of the 57 analyzed patients, 25 (43.86%) were female and 32 (56.14%) were male. Mean age was  $45.67 \pm 14.36$  years with median

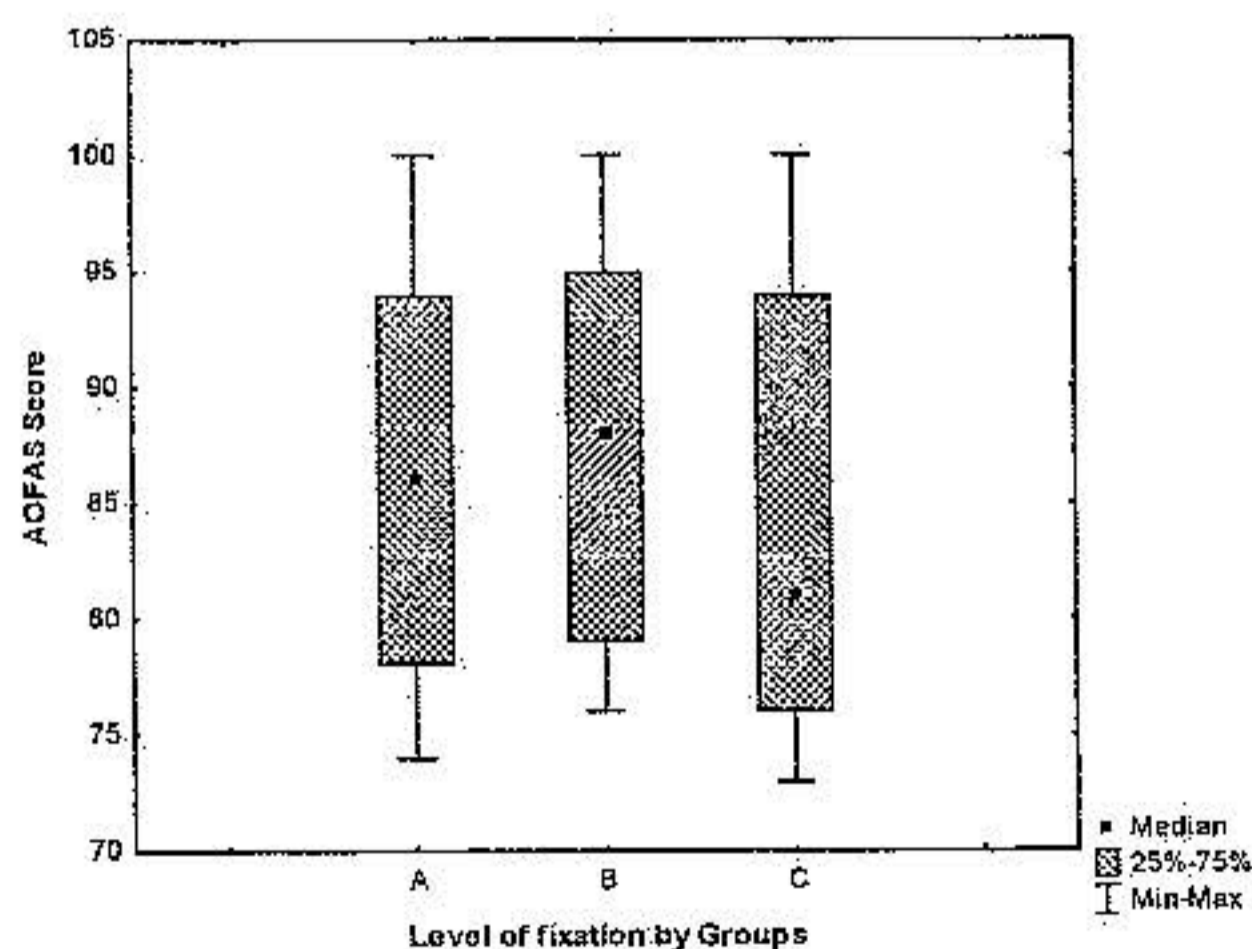
(IQR)=45 (35-55) and minimum/maximum age of 18/73. Descriptive analysis of sample by selected parameters is presented in Table 1.

The analysis showed no significant differences between three groups with different level of fixation related to AOFAS score (Kruskal-Wallis H test:  $X^2(2)=3.048$ ;  $p=0.2179$ ; Figure 1).

**Table 1** Goals of anatomy education Descriptive analysis of sample by selected parameters

Parameters	Level of fixation by groups		
	A	B	C
	≤ 20 mm	21-40 mm	≥ 40 mm
Gender			
female	10 (17.54%)	8 (14.04%)	7 (12.28%)
male	7 (12.28%)	13 (22.81%)	12 (21.05%)
Age			
Mean ± SD	45.53±13.31	46.14±14.85	45.26±14.43
Median (IQR)	48 (38-55)	46 (35-55)	42 (33-59)
Mechanism of injury			
High energy trauma	7 (12.28%)	11 (19.30%)	9 (15.79%)
Low energy trauma	10 (17.54%)	10 (17.54%)	10 (17.54%)
Fracture Type (Denis Weber)			
B	9 (15.79%)	10 (17.54%)	10 (17.54%)
C	8 (14.04%)	11 (19.30%)	9 (15.79%)
AOFAS score			
Mean ± SD	86.35±8.78	88.05±8.42	83.68±9.05
Median (IQR)	86 (78-94)	88 (79-95)	81 (76-94)

SD - Standard deviation; IQR - Interquartile range



**Figure 1** Groups of different level of fixation related to AOFAS score

## Discussion

Despite being very common, ankle fractures still pose considerable challenge to the skeletal surgeons. They represent more than a half of foot and ankle injuries combined [23]. At the same time, it has been estimated that the fractures represent an increasing fraction of ankle injuries, while ligamentous injuries have been decreasing which also increases the cost of treating ankle injuries in general [24]. These figures are the main driving force of the extensive research focused on ankle fractures, and the published research has emphasized the role of the distal tibiofibular syndesmosis accompanying ankle injury as a key component of the treatment. Since the seminal work of Ramsey and Hamilton [25] who published their results of the changes of the contact area of the articular surfaces of the ankle caused by only 1 mm of lateral translation of the talus within the ankle mortise, it became apparent that the surgical treatment of ankle fractures with syndesmotic disruption would be a field of details, emerging and changing on an everyday basis. Several decades later, the highly sophisticated studies still state that the restoring normal relation between distal tibia and fibula at the level of syndesmosis is a must while counting on the good functional result [16]. In the present study, the authors have been focused on a single aspect of syndesmotic fixation following its traumatic disruption, which is the level of placement of the metallic screw as measured from the tibial plafond.

The study group consisted of 57 examinees who were classified into three groups based on the level of screw placement. Although the functional score measured a year post injury was higher in group B, followed by group A and group C, the differences were not statistically significant. The groups were homogeneous regarding gender, age, mechanism of injury and type of the fracture according to Denis-Weber classification.

The frequently cited study of Kukreti *et al.*, describes 60 examinees in a retrospective manner, comparing functional and radiological parameters with regard to the level of syndesmotic fixation: 2 centimeters above the tibial plafond being the limit between the transsyndesmotic and suprasyndesmotic group. The authors failed to demonstrate the statistically significant differences in functional outcome with regard to the level of fixation [26]. However, they concluded that the inferior tibio-fibular synostosis has a higher incidence in the transsyndesmotic group. This complication was not noted in our study.

Another study focused on the level of syndesmotic fixation was cadaveric, describing two groups: one in which the syndesmosis was fixed at the level of 2 cm above the tibiotalar joint and another, with the fixation at the level of 3.5 cm above the tibiotalar joint [15]. The results showed biomechanical superiority of the fixation at the level of 2 cm. Whether these biomechanical observations have relevance *in vivo* is controversial.

In 2012, a nationwide survey focused on management of acute distal tibio-fibular syndesmotic injuries was published [27]. The survey included 142 practicing surgeons all over the Netherlands. In terms of the level of syndesmotic screw placement, their answers showed that most of them (74.4%) place the screw at the level of 2.1-4.0 cm above the tibial plafond, while 5.8% and 17.4% place the screw at the level below 2.0 cm and above 4.1 cm, respectively. According to this result, it seems that most of the surgeons are simply following the recommendations from the widely popular books on skeletal trauma [17,28].

Yet, another study looked at the clinical outcome with regard to the level of the positioning screw placement following syndesmotic disruption [29]. In a study including 122 patients, most of the patients had the screw placed in a "median" group – 21- 40.99 mm above the pilon, with 26% and 21% below and above, respectively. Those in the group of 21- 40.99 mm had the best mean AOFAS score and those above had the worst mean score; however, the differences were not statistically significant.

According to our knowledge, no study, including the present one demonstrated statistically significant higher functional scores at certain level of screw placement. However, the higher scores in group B (corresponding to 21- 44 mm group in other studies) should not be underestimated. It seems that those in whom the positioning screw has higher position demonstrate lower functional scores, which might be due to the anatomical inward bending of the fibula that can predispose, even theoretically, to mortise widening [30].

Our study is limited by its small number of examinees driven by a single hospital and the small number of parameters taken into account. On the other hand, the exclusion criteria were quite strict, in order to eliminate the possible bias that may be present due to several technical aspects that may be taken into account while operating on ankle fractures with syndesmotic disruption. The authors of the present study do recommend the placement of the positioning screw at the level of 21-40 mm above the tibial plafond.

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