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Original article

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Impact of excess weight on surgical treatment of the ankle joint

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Abstract:
Objective: to assess the possible effect of excess body weight on the results of surgical treatment outcomes of ankle osteoarthritis.
Materials and Methods.Our study sample included 134 patients with moderate to advanced ankle osteoarthritis who underwent supramalleolar osteotomy or ankle arthrodesis.Patients were distributed among four groups according to their body mass index values: A) underweight (BMI≤18.5kg/m2), B) normal weight (18.5<BMI≤25 kg/m2), C) overweight (25<BMI ≤30 kg/m2) and D) obese (BMI>30 kg/m2). All study subjects were monitoredduring more than six months.they were evaluated physically, as well as by theVisual Analog Scale (VAS) scores and American Orthopaedic Foot and Ankle Society (scores).
Results. Postoperative AOFAS and VAS scores at three months and six months were significantly better in all four groups vs. the preoperative scores. A comparison of the preoperative AOFAS and VAS scores yielded no significant differences between the four groups (p=0.505, p=0.779). A comparison of the AOFAS and VAS scores six months after the surgery revealed no significant differences between the four groups as well (p=0.313, p=0.711).
Conclusion.For the moderate and advanced osteoarthritis stages, supramalleolar osteotomy and ankle arthrodesis exhibited the highest effectiveness regardless of the patient excess body weight. During the early rehabilitation period, excess body weight did not affect the degree of pain and functional recovery after the ankle surgery.

Keywords: body mass index, supramalleolar osteotomy, ankle arthrodesis, osteoarthritis.

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Introduction

Obesity is defined as weight gain caused by excessive accumulation of adipose tissue in the body. Currently, over 1 billion people worldwide are overweight, of whom approximately 300 million are obese, which constitutes a major public health problem [1]. Body mass index (BMI) is habitually used to assess obesity. Elevated BMI values are associated with increased incidence of osteoarthritis (OA) [2]. Besides, elevated BMI is thought to have a negative impact on surgical outcomes, increasing the risk of complications after hip surgery [3]. However, from the standpoint of postoperative rehabilitation, an increase in BMI does not affect the degree of pain symptoms in patients who underwent hip surgery [4]. Nonetheless, there are limited studies that specifically evaluated the impact of obesity on the ankle surgery outcome. Our study aimed to assess the effect of BMI on pain severity and functional recovery after ankle surgery using theVisual Analog Scale(VAS) and American Orthopaedic Foot and Ankle Society (AOFAS) scores.

Objective –to evaluate the possible impact of excess body weight on the surgical treatment outcomes of ankle osteoarthritis.

Materials and Methods

Study sample

The experiment was carried out from January 2018 through February 2022. The study protocol was approved by the regional Ethics Committee. A contract was concluded with each patient confirming his or her consent to participate in the study.

The study involved 134 patients diagnosed with moderateto advanced stage of OA. All patients received surgical treatment. Preoperative height, weight, and BMI were measuredin all participants. Subsequently, they were distributed among four groups according to their BMI values. Group A included underweight patients (BMI≤18.5 kg/m2).Group B comprised normal weight patients (18.5<BMI≤25 kg/m2).Group C encompassed overweight subjects (25<BMI≤30 kg/m2), whileGroup D involved obese individuals (BMI>30 kg/m2). All patients were monitored for at least sixmonths.Groups A< B, C and D included 13 patients (7 men and 6 women, 51±13 years of age), 41 patients (18 men and 23 women, 55±13 years of age), 63 patients (25 men and 38 women, 56±11 years of age) and 17 patients (6 men and 11 women, 59±9 years of age), correspondingly.

Surgical methods

One of the most common classifications used in assessing the condition of the ankle in a clinical setting is the Takakura classification. The following stages are distinguished: stage I (identical to early), middle and late stages [5].

Our choice of surgical method was primarily based on the patient's OA stagesensu the Takakura classification. Supramalleolar osteotomy was used in patients with stages II and IIIa asymmetric OA while preserving at least 50% of healthy cartilage in the ankle joint [6]. Ankle arthrodesis was employed in patients with stages IIIb and IV OA [7].

Study protocol

Each patient underwent a physical examination (examination of anamnesis, palpation, assessment of joint mobility, resting position of the joint, presence of erythema, comparison with a healthy joint of the patient or the doctor, if both joints of the patient were affected). The examination using AOFAS and VAS was carried out before and after surgery. The latter scale is intended to analyze the pain syndrome and functioning of the ankle joint [8]. AOFAS and VAS were used in the course of comparing functional and pain recovery of the four groups of patients before surgery and at three and six months after it.

Statistical data processing

Statistical analyses were performedvia the SPSS 26.0. Quantitative data were expressed as mean ± standard deviation (X±S). Student's t-test was employed to test the equality of meansin different groups. The sample was preliminarily checked for normality of distribution. One-way ANOVA was used to compare data between multiple groups at once. The results were considered statistically significantat $P<0.05$. The chi-squared test was also used to analyze the collected data.

Results

We revealed no significant differences in age, gender, affected limb, or type of surgery between the four groups of patients (*Table 1*).

AOFAS scores in all four groups at three months after surgery were significantly higher vs. preoperative values (p=0.004-0.008). AOFAS scores at six months after surgery were also significantly higher, compared with the previous study period (p=0.005-0.009) (*Table 2*).

VAS scores were significantly lower in all four groups at three months after surgery vs.preoperative values (p=0.006-0.009). Also, VAS scores were significantly lower at six months after surgery, compared with the previous study period (p=0.008-0.032) *(Table 3*).

Differences in AOFAS scores between groups during different study periods were further analyzed. We established no significant differences in AOFAS scores between groups before surgery (F=0.783; p=0.505), as well as atthree months (F=1.482; p=0.222) and six months after surgery (F=1.200; p=0.313).

VAS scores were also analyzed between groups during different study periods. We found no significant differences in preoperative period and at six months after surgery (p=0.222-0.505).

Table 1. General characteristics of the four patient groups

Parameters	Group				F/χ^2	P
	A (n=13)	B (n=41)	C (n=63)	D (n=17)		
Age, years	51±13	55±13	56±11	59±9	F=1.139	0.336
Body mass index	17.7±0.3	22.9±1.3	27.1±1.1	31.4±1.2	F=441.065	0.009
Gender (Male: Female)	7:6	18:23	25:38	6:11	χ^2=1.262	0.738
Affected limb (Left: Right)	5:8	17:24	35:28	12:5	χ^2=5.433	0.143
Surgery type (Osteotomy: Arthrodesis)	6:7	18:23	20:43	8:9	χ^2 =2.554	0.466

Table 2. Comparison of American Orthopedic Foot and Ankle Society scores across study periods

Group	Preoperative AOFAS score	Postoperative AOFAS score	
		after 3 months	after 6 months
A(n=13)	34.6±7.7	66.8±3.9	76.7±3.7
	t=-13.520, p=0.008	t =-12.985, p=0.009	
B(n=41)	34.5±7.0	65.9±3.3	75.7±3.7
	t=-25.969, p=0.006	t=-30.964, p=0.005	
C(n=63)	33.0±4.5	66.2±3.9	75.7±4.7
	t=-42.714, p=0.004	t=-22.326, p=0.007	
D(n=17)	32.7±4.5	68.1±4.6	77.8±5.4
	t=-23.012, p=0.007	t=-10.053, p=0.009	

Table 3. Comparison of Visual Analog Scale (VAS) scores across different study periods

Group	Preoperative VAS score	Postoperative VAS score	
		after 3 months	after6 months
A(n=13)	6.8±0.6	3.4±0.6	2.8±0.9
	t=18.762, p=0.007	t=3.742, p=0.032	
B(n=41)	6.9±0.7	3.8±0.9	2.9±0.9
	t=17.162, p=0.007	t =8.039, p=0.009	
C(n=63)	7.0±0.8	3.6±0.7	2.8±0.8
	t =26.238, p=0.006	t=11.810, p=0.008	
D(n=17)	6.9±0.7	4.1±0.7	3.0±0.7
	t =12.813, p=0.009	t=7.856, p=0.009	

Before surgery and at six months after it, no differences between groups were detected as well (F=0.365, p=0.779; and F=0.459, p=0.711, respectively).

Further analysis yielded a statistically significant difference in VAS scores between Group A and Group D at three months postoperatively. The obese group patients had stronger ankle pain (t=-2.586, p=0.015) than the underweight group (t=-1.390, p=0.170).

Discussion

M. Kimizuka, H. Kurosawa and T. Fukubayashi [7] noted that the contact area size in the ankle, hip, and knee is 350 mm2, 1,100 mm2 and 1,120 mm2 under a load of 500 N. It is

well known that the articular surface of the ankle joint is subject to greater load per unit area. Increasing body weight further raises the risk of developing OA due to damage to joint surfaces and other musculoskeletal structures caused by repetitive stress during resistance exercise [9]. Ankle OA can cause pain and limit joint function; consequently, patients experience reduced quality of life [2]. Supramalleolar osteotomy and ankle arthrodesis are the most common methods of OA treatment. The difference is that supramalleolar osteotomy is an organ-sparing surgery that attempts to redistribute the load on the ankle by restoring the mechanical axis and slowing the progression of ankle OA [10, 11]. At the same time, ankle arthrodesis is intended to relieve joint pain and restore limb support [12]. In our study, these surgical techniques were effective in treating moderateandadvanced stages of ankle OA, regardless of the patient's degree of obesity.

Since obesity negatively affects ankle kinematics and kinetics during walking [9], we can assume that elevated BMI values negatively affect postoperative recovery in case of ankle surgery. Nevertheless, more recent research showed that obesity increased the risk of peri- and postoperative complications, readmission and revision rates, as well as overall health care costs. However, there is no direct connection of the musculoskeletal system diseases with the prognosis and treatment outcomes; rather, there is an indirect effect through obesity-caused multimorbidity [2]. A study by D. Pérez-Prieto et al. [1] also revealed no correlation between BMI and postoperative AOFAS and VAS scores in surgical treatment of metatarsalgia. Similar results were obtained in our study, although at three monthspostoperatively, the obese group experiencedstronger ankle pain than the underweight group. However, at six monthsafter surgery, we no longer observedstatistically significant differences between the groups.

Conclusion

Hence, regardless of the level of excess body weight in the patient, for the moderate and advanced stages of OA, supramalleolar osteotomy and ankle arthrodesis exhibited maximum effectiveness. During the period of early rehabilitation, there was no negative impact on the degree of manifestation of pain symptoms and functional recovery after ankle surgery.

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Conflict of interest: None declared

References

1. Pérez-Prieto D, Cuenca M, Marí R, et al.The impact of Body Mass Index on metatarsalgia surgical outcomes. *Int Orthop* 2019; 43(6): 1443-1447. https://www.doi.org/10.1007/s00264-018-4067-8
2. Midgley J. Osteoarthritis and obesity; conservative management, multi-morbidity, surgery and the implications of restricted access to knee or hip replacement: A literature review. *Int J Orthop Trauma Nurs* 2021; 40: 1-5. https://www.doi.org/10.1016/j.ijotn.2020.100840
3. Akhtyamov IF, Zhi HH, Faizrakhmanova GM, et al. Total hip replacement in obese patients with obesity (Meta-analysis of prospective cohort studies). *Traumatology and Orthopedics of Russia* 2019; 25(1): 177-87. (In Russ.).
4. Ardashev SA, Akhtyamov IF, Chzhi HH. Prevention of postoperative pain syndrome in patients with pathology of the hip joint due to obesity. *Bulletin of the Medical Institute "REAVIZ". Rehabilitation, Doctor and Health* 2022; 12 (5): 37-42. (In Russ.).
5. Suo H, Fu L, Liang H, et al. End- stage ankle arthritis treated by ankle arthrodesis with screw fixation through the transfibular approach: A retrospective analysis. *Orthop Surgery* 2020; 12(4): 1108-19. https://www.doi.org/10.1111/os.12707.
6. Herrera-Pérez M, Valderrabano V, Godoy-Santos AL, et al.Ankle osteoarthritis: Comprehensive review and treatment algorithm proposal. *EFORT Open Rev*. 2022; 7(7): 448-59. https://www.doi.org/10.1530/EOR-21-0117
7. Kimizuka M, Kurosawa H, FukubayashiT. Load-bearing pattern of the ankle joint. *Arch Orthop Trauma Surg*. 1980; 96(1): 45-9. https://www.doi.org/10.1007/BF01246141
8. Bai Z, Yang Y,Chen S, et al.Clinical effectiveness of arthroscopic vs. open ankle arthrodesis for advanced ankle arthritis: A systematic review and meta-analysis. *Medicine* 2021; 100(10): 1-9. https://www.doi.org/10.1097/MD.0000000000024998
9. Capodaglio P, Gobbi M, Donno L, et al. Effect of obesity on knee and ankle biomechanics during walking. *Sensors (Basel)* 2021; 21(21): 1-11. https://www.doi.org/10.3390/s21217114
10. Khominets VV, Mikhailov SV, Shchukin AV, et al. Features of surgical treatment of patients with non-infectious complications of malleolar segment fractures (Literature review). *Preventive and Clinical Medicine* 2021; (2): 82-91. (In Russ.).
11. Yang XQ, Zhang Y, Wang Q, et al. Supramalleolar osteotomy *vs.* arthrodesis for the treatment of Takakura 3B ankle osteoarthritis. *Foot Ankle Int*. 2022; 43(9): 1185-93. https://www.doi.org/10.1177/10711007221099183
12. Fomichev VA, Sorokin EP, Chugaev DV, et al.Ankle fusion as the optimal surgical option in the treatment of patients with terminal stage of ankle osteoarthritis(Literature review). *Department of Traumatology and Orthopedics* 2019; 4 (38): 18-26.(In Russ.).

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