



ORIGINAL ARTICLE

The Impact of Cryotherapy on Reducing Postoperative Periorbital Ecchymosis and Nasal Edema in Patients undergoing Rhinoplasty

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ABSTRACT

One of the selective treatment approaches to reduce localized edema after rhinoplasty is a non-pharmacological method called cryotherapy. In this regard, the current study was an attempt to identify the impact of cryotherapy on reducing postoperative periorbital ecchymosis and nasal edema in patients undergoing rhinoplasty. This study was conducted as a clinical trial on a total of 70 rhinoplasty candidates from Shahid Rajaee Hospital in Ghachsaran in 2013. Patients were assigned to two 35-subject control and experimental groups. The patients' demographic data were gathered through record questionnaire and then the registration form of edema rate measuring per patient was separately regulated. The cryotherapy was applied into the experimental group using a researcher-made gel pack while the control group did not receive any treatment. The amount of edema on both right and left sides of the nose was measured in both groups at a half hour, 1-, 6- and 24-hour intervals postoperatively. The gathered data were then analyzed performing Greenhouse-Geisser test using SPSS 20.0. The rate of postoperative edema and ecchymosis was regularly increased in both control and experimental groups; however, the increase in the control group was significantly higher than the experimental group. The statistical significance level was almost $p < 0.001$. Thus, there exists a significant interactional effect between measuring time and selective groups. The results revealed a significant difference between the experimental and control groups with respect to the effect of cryotherapy which was applied to the experimental group, beginning a half hour, 1, 6 and 24 hour postoperatively to reduce postoperative periorbital ecchymosis and nasal edema. Therefore, it could be stated that using cryotherapy peri- and post-op rhinoplasty could significantly reduce the amount of edema and ecchymosis appeared after the surgery.

Keywords: cryotherapy, nasal edema, periorbital ecchymosis and edema, rhinoplasty

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INTRODUCTION

The history of cryotherapy in medicine dates back to prehistoric records that Hippocrates recommended ice for the treatment of fresh injuries. Iranian genius scientist as Abn-Syna in his rule book suggested ice and water for lessening the pain and inflammation resulted from parenthesis. Likewise, a book titled therapeutic use of ice was published by Thomas Bartholin in 1661 in Italy. It is notable to point to the proven impacts of ice on reducing and preventing the progression of inflammation in the early stages of trauma injuries [1]. Coldness had been used for many years to treat acute injuries such as reducing inflation and edema and relieving pain. Coldness has also been used for temporary reduction of increased muscle tone and bleeding control. Askari-Ashtiyani et al, in their study on the effect of cryotherapy in the treatment of acute injuries and increase of muscle strength in 18-20-year-old adolescents, found that cryotherapy is one of the most effective rehabilitation treatments to increase the wrist muscle strength of patients [2]. Another clinical implication of cryotherapy was reported in patients with rheumatoid arthritis. In this study, it was observed that cryotherapy results in arthritis pain relief through reducing the secretion of histamine and it also increases the range of motion in inflamed joints [3]. Regarding the rehabilitation of musculoskeletal injuries, immediate cryotherapy is beneficial in the acute phase of edema - which functions through reducing metabolism and increasing vasoconstriction in inflammatory response. Besides, cryotherapy has many applications in minimizing the pain and inflammation caused by

physical exercises and sports. Post-workout muscle soreness could be reduced by soaking in cold water with a temperature lower than 15°C [5].

Studies in athletes demonstrated that soaking in cold water immediately after intense and prolonged exercising impedes severe muscle damage and destruction of tissues through reducing hemangiogenesis and lymphangiogenesis responses and it also lessens muscle pain and spasms and prevents tissue damage by reducing edema [6]. Studying the impact of cryotherapy on ankle blood flow peri- and post-op surgery-regarding different parameters, it was found that cryotherapy is effective in capillary vasodilation, altered metabolism and reduction of tissue inflammation. It was also discovered to be effective in acute tissue injury by reducing the inflammatory cytokine. Coldness reduces swelling and pain by specific mechanisms. Studying the ankle microcirculation parameters in healthy people, the Cairo Cuff device for more than 30 minutes was found to reduce the amount of oxygen saturation at feet surface area while keeping it at feet depth. This device, which is a combination of coldness and pressure, has a significant effect on reducing pain peri- and post-op surgery that reveals the importance of cryotherapy [7]. The clinical benefits of cryotherapy include the ease of use, maintenance of bone mineral density and very low incidence of infection; and it is more locally used in the desired location and can be repeated without permanent complications. Due to using coldness in cryotherapy, vasoconstriction happens; and consequently there will be less bleeding [8].

Rhinoplasty is one of the most common cosmetic surgery procedures, which is pursued to enhance beauty. This surgery could develop some complications. Rhinoplasty-complications can be divided into two general groups: (1) symptoms that interfere with the function of the nose. [2] symptoms that appear to be projected in the nose appearance. The first causes some complications such as (1) attachment and adherence of the nose (2) nasal septal deviation (3) large nasal turbinate (4) nasal valve stenosis. The second group relates to deformity of the nose after rhinoplasty. The later complications are much more versatile than the former [9]. The hyperpigmentation around the eyes and apparent nasal edema constitute the second group's complications which are developed post-op rhinoplasty surgery [11]. One of the postsurgical dissatisfaction expressed by patients is related to severe conjunctival ecchymosis (ecchymotic eyelids). Internal nasal trauma could also occur in the form of perforation of the nasal mucosa leading to long-term postsurgical edema and ecchymosis (12). Many studies are conducted upon avoiding or reducing the edema and ecchymosis by taking cortisone effects (steroid) into account. Glucocorticoids lead to the reduction or prevention of inflammatory processes without removing the underlying cause. Nowadays, dexamethasone is used to reduce nasal and upper-eyelids edema and ecchymosis that results in the reduction of postoperative down-lids edema within the first 48 hours and reduction of postoperative ecchymosis within the first 24 hours postoperatively. However, this medication does not have any effect on reducing blood loss during surgery and during the recovery period [13]. Other suggested drugs like methylprednisolone can also quickly reduce edema after a rhinoplasty surgery. As one of the non-pharmacological approaches to postoperative care with fewer complications than synthetic drugs, it is suggested applying ice in an ice pack to the back of the nose and near the surgical site in order to reduce edema and bruising provided that the ice bag is not placed on the eye or on the cornea of the eye. This has to be continued for forty-eight hours postoperatively to reduce swelling around the eyes [15].

Given the literature review above, coldness also causes vasoconstriction and diminishes permeability of the cells. These immediate effects limit the inflation rate and decrease metabolism of the damaged area and its surrounding tissues. Coldness also appears to increase pain threshold and to reduce resulting muscle spasms through reducing the amount of nerve impulses in motor and sensory peripheral nerves [16]. To reduce the pain, treatments other than medication is administered in nursing care programs including cryotherapy. In thoracotomy, coldness reduces pain by blocking nerve impulses [17].

Kullenberg et al. (2006) indicated that intense cryotherapy has more effects on the reduction of pain and edema developed in skeletal muscle damage than anti-inflammatory drugs; and the recovery period would be accelerated. They also concluded that by affecting the ability and the reduction of hard-muscle connections, cryotherapy reduces muscle pain and muscle spasm and stimulates soft tissue healing (tissue repair) [18]. In addition, cryotherapy improves patient comfort and can immediately diminish the amount of edema and pain [19]. Examining the intralesional injection into hypertrophic scars using 7-to-24-minute cryotherapy to reduce hypertrophic scars - depending on the size of hypertrophic scars - , Shadi et al noticed a significant reduction in the dependent variables (stiffness, redness) as well as a reduction in pain complaints and peri- and post-surgical bleeding. Furthermore, no surgical site infection was observed that is an operational effectiveness of cryotherapy during surgical procedures [20].

To this end, the current study aimed to reduce postoperative edema and ecchymosis as well as to reduce bleeding during a rhinoplasty surgery. Due to the high occurrence of such postoperative edema and ecchymosis and also owing to the fact that no research has been found that surveyed the effect of

cryotherapy on reducing postoperative periorbital ecchymosis and nasal edema as well as reducing peri- and post-surgical bleeding in patients undergoing rhinoplasty, the authors presumed that using cryotherapy can greatly reduce the facial ecchymosis and nasal edema and lead to patients avoiding anti-inflammatory drugs with various complications; as a result, the recovery process would be hastened and the patient satisfaction is gained. It is hoped that the results of this research could be used to prevent postoperative discomforts and also to demonstrate effectiveness in education, research and nursing services.

MATERIALS AND METHOD

With the approval of the Regional Research Ethics Committee of the Medical Sciences of Isfahan University of Medical Sciences and also the research deputy director of Khorasgan University, this clinical study was carried out in 2013 to identify the effects of cryotherapy on reducing postoperative periorbital ecchymosis and nasal edema in patients admitted to Shahid Rajaei Hospital in Ghachsaran County, Isfahan, Iran. The patients were assigned to two control and experimental groups, each containing a total of 35 subjects. All patients underwent rhinoplasty surgery. Meanwhile, the experimental group received an application of cryotherapy using a gel pack as a pre-, peri-, and post-op treatment. The content validity evaluation was used in order to determine the validity of the instruments. To do so, the questionnaire was developed according to reference books and scholarly nursing journals and the use of some valid questionnaires derived from clinical trial papers of cryotherapy.

While the patient was fully under care, the cold pad having a temperature of -5°C was applied to both sides of the patient's face and around nose, beginning 1 hour preoperatively. With the approval of the specialist, the researcher was physically present during the surgery and controlled the pad up until the surgery was terminated. In the meantime, if the pad temperature – shown through a thermometer installed on the pad – came down during surgery, it was replaced by a new one with a temperature of -5°C . It is worth mentioning that the temperature was maintained between -5 to 5°C ; and to preserve the coldness longer, -5° -centigrade cold pads were placed on patient's cheeks. The cold pad was replaced in case its temperature exceeded 5°C above zero. The amount of post surgical edema was observed and recorded at a half hour, 1-, 6-, and 24-hour intervals postoperatively. This observation was made by people who were already trained in how to measure edema and ecchymosis of muscle and skeletal tissues and also who had not previously observed the designated site. They offered their observations of the desired troughs areas on an observation checklist. Furthermore, the amount of periorbital edema was measured using a standard rating instrument that moved from the inner cantus to outer cantus.

The pressure points around the nose were also randomly selected. The measuring happened once during the designated intervals. The amount of pressure on the inflamed nasal areas was to the point that the index finger touched the bones around or near the nose and also the cheekbones and then the observation was recorded on the Information Registration Form. No special treatment, however, was applied to the control group. The amount of nasal edema and periorbital ecchymosis in both control and experimental groups were recorded after the surgery, beginning a half hour postoperatively and for 1, 6 and 24 hours thereafter. After the patients were discharged from the hospital or health center, registering the required information on both groups was pursued for 24h after the surgery at the patients' residence with the patients' or their companies' permission. Both groups were carefully observed and they were comparatively studied to identify the effect of the treatment i.e. cryotherapy on the reduction of inflammatory tissues around their nose and under their eyes.

The measuring scale of periorbital and nasal edema was determined as the following:

- +1 to 2mm in size which rapidly disappears
- +2 to 4mm troughs in the skin which lasts for 10 to 15 seconds
- +3 to 6mm troughs in the skin which lasts for more than 1 minute
- +4 with a size of 8mm lasting for more than 2 to 3 minutes
- 0- no troughs
- +1 low troughs - less than 2 mm
- +2 troughs ranging from 2 to 4 mm
- +3 troughs ranging from 5 to 8 mm
- +4 troughs more than 8 mm (22).

Moreover, the extent of periorbital edema (upper and lower eyelid) was scored as: 0 = no edema, 1 = minimum edema, 2 = covering the iris, 3 = pupil inclusion and 4 = extensive edema (23). Examining the postoperative periorbital ecchymosis (upper and lower lids) based upon the 0-to-4 point scoring system includes: 0 = no ecchymosis, 1 = in the medial or middle of cantus, 2 = suppressed to the pupil, 3 = passed the pupil, 4 = close to the lateral cantus (24).

Eligibility criteria of the samples include:

- 1) During the procedure, the patients have to be admitted to Shahid Rajaei Hospital in Ghachsaran
- 2) Patients should be Ghachsaran residents or reside in Ghachsaran for 24h after the surgery
- 3) Patients should be willing to participate in the study
- 4) Patients with the age ranging from 20 to 40 max
- 5) Patients who are able to complete the questionnaire or to undergo rhinoplasty surgery
- 6) Patients should not express any diseases which could interfere with the rhinoplasty surgical procedure
- 7) Patients referring only for rhinoplasty surgery
- 8) Rhinoplasty surgical procedure in this study has to be performed in a closed-wedge technique

Non-eligibility criteria include:

- 1) Request for withdrawal from the study before, during and after the surgery and up to the data analysis process
 - 2) Failure to therapeutically comply with the pre- and post-operative instructions given to the patients
 - 3) If patients develop complications during the investigation and need to be re-operated or transferred to another section
 - 4) If the patients have a history of medication use which could interfere with the surgery or influence it
- To describe the data, distribution parameters and frequency distribution tables were used and also parametric and nonparametric tests were employed to further analyze the data. The gathered data were then examined performing descriptive statistical tests, t-test and Greenhouse-Geisser test using SPSS 20.0. $P < 0.05$ was assumed to be statistically significant.

RESULTS

The majority of the participants ranged in age from 20 to 25 with the highest frequency (65.7%) belonging to the age group of 20-25 years old. In terms of marital status, most of the participants with a frequency of 75.7% were single. With regard to the gender, of the total 70 participants, both males (50%) and females (50%) were equally distributed. In terms of education, most subjects (54.3%) had a diploma. According to the results obtained within a half hour postoperatively, the amount of nasal and right periorbital edema of the patients in experimental group was seen to be the lowest with a mean score of 0.0857 and SD 0.28403 compared to that of the control group within the same period of time with a mean score of 0.7714 and SD of 0.84316 ($p < 0.05$) (Table 1-1).

During a half hour observation, the mean score and the SD of nasal and right periorbital edema and ecchymosis of the experimental group came out to be 0.1143 and 0.32280, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 0.6857 and 0.63113, respectively ($p < 0.05$) (Table 1-1).

Within the 1-hour observation, the mean score and the SD of nasal and left periorbital edema and ecchymosis of the experimental group came out to be 0.1143 and 0.32280, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 1.5 and 1.36662, respectively ($p < 0.05$) (Table 1-1).

Within the 1-hour observation, the mean score and the SD of nasal and right periorbital edema and ecchymosis of the experimental group came out to be 0.1129 and 0.35504, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 1.4857 and 1.09468, respectively ($p < 0.05$) (Table 1-1).

Within the 6-hour observation, the mean score and the SD of nasal and left periorbital edema and ecchymosis of the experimental group came out to be 0.1143 and 0.32280, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 3.100 and 1.95839, respectively ($p < 0.05$) (Table 1-1).

Within the 6-hour observation, the mean score and the SD of nasal and right periorbital edema and ecchymosis of the experimental group came out to be 0.0857 and 0.28403, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 2.9571 and 1.73363, respectively ($p < 0.05$) (Table 1-1).

Within the 24-hour observation, the mean score and the SD of nasal and left periorbital edema and ecchymosis of the experimental group came out to be 0.4857 and 0.65849, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 4.9286 and 2.1139, respectively ($p < 0.05$) (Table 1-1).

Within the 24-hour observation, the mean score and the SD of nasal and right periorbital edema and ecchymosis of the experimental group came out to be 0.5714 and 0.65465, respectively which are the lowest amount of edema compared to that of the control group with the mean and standard deviation of 5.0571 and 2.03561, respectively ($p < 0.05$) (Table 1-1).

Table (1-1) Binary comparison of mean and standard deviation of nasal and left/ right periorbital edema in the specified post-operation successive times in both experimental and control groups

Time span	Groups	N	Mean and SD of left periorbital edema	Level of significance	Mean and SD of right periorbital edema	Level of significance
30 minutes	experimental	35	0.0857±0.28403	p<0.001	0.1143±0.32280	p<0.001
	control	35	0.7714±0.84316	p<0.001	0.6857±0.63113	p<0.001
1 h	experimental	35	0.1143±0.32280	p<0.001	0.1129±0.35504	p<0.001
	control	35	1.5000±1.36662	p<0.001	1.4857±1.09468	p<0.001
6 h	experimental	35	0.1143±0.32280	p<0.001	0.0857±0.28403	p<0.001
	control	35	3.1000±1.95839	p<0.001	2.9571±1.73363	p<0.001
24 h	experimental	35	0.4857±0.65849	p<0.001	0.5714±0.65465	p<0.001
	control	35	4.9286±2.11139	p<0.001	5.0571±2.03561	p<0.001

According to the table above, an increase is observed within the specified time intervals in the inflammation of periorbital and nasal tissues of both groups. The increase in the severity of the edema was not similar in both groups; and this process seems to occur longer in the control than experimental group. This inflammatory increase after 24 hours of surgery could be clearly observed in the control group. In this case, the significance level of the test is approximately zero (p<0.001). Therefore, it could be concluded that there exists a significant interactional effect between measuring time and the groups indicating that peri- and post-operative cryotherapy significantly reduces the amount of edema resulted from rhinoplasty surgery.

Table (1-2) Greenhouse-Geisser test results for the between-group and interactional effects (edema amount)

Source of variation	Sum of squares	df	Mean square	Test statistic	P-value
Measuring time	225.058	2.129	119.829	174.286	0.000
Interactional effect of measuring time and groups	190.615	2.129	89.553	130.251	0.000
Error	99.514	144.739	0.688		

The Greenhouse-Geisser test results show that there exists a significant increase in the average inflation rate during four phases of postoperative measurement (p<0.001).

In addition to the total sample, this increase in the inflation rate is also observed in each of the individual groups. The test results indicate an interactional effect between measuring time and the experimental group. The level of significance in this case is nearly zero. Therefore, it could be concluded that there exists a significant effect between measuring time and the groups. To this end, the amount of edema was not similar in both groups meaning that it is higher in the control group. It could be stated that peri- and post-operative cryotherapy can significantly reduce the amount of edema resulted from rhinoplasty surgery

Table (1-2) Binary comparison of mean and standard deviation of nasal and left/ right periorbital edema in the specified post-operation successive times in both experimental and control groups

Time span	Groups	N	Mean and SD of left periorbital edema	Level of significance	Mean and SD of right periorbital edema	Level of significance
30 minutes	experimental	35	0.3143±0.63113	p<0.001	0.4000±0.65079	p<0.001
	control	35	0.7714±0.59832	p<0.001	0.6857±0.63113	p<0.001
1 h	experimental	35	0.3429±0.63906	p<0.001	0.4000±0.65079	p<0.001
	control	35	1.6429±1.38038	p<0.001	1.6000±1.06274	p<0.001
6 h	experimental	35	0.3429±0.63906	p<0.001	0.4571±0.78000	p<0.001
	control	35	3.2284±1.72073	p<0.001	3.1571±1.92419	p<0.001
24 h	experimental	35	0.6286±0.87735	p<0.001	0.7714±0.84316	p<0.001
	control	35	5.7429±2.19079	p<0.001	5.0857±2.01277	p<0.001

According to the table above, an increase is observed within the specified time spans in the inflammation of periorbital and nasal tissues in both groups. The increase in the severity of the edema was not similar in both groups; and this process seems to occur longer in the control than the experimental group. This inflammatory increase after 24 hours of surgery could be clearly observed in the control group. In this case, the significance level of the test is approximately zero ($p < 0.001$). Therefore, it could be concluded that there exists a significant interactional effect between measuring time and the groups which indicates that peri- and post-operative cryotherapy can significantly reduce the inflammatory rate resulted from rhinoplasty surgery.

Table (1-2) Greenhouse-Geisser test results for the between-group and interactional effects (edema amount)

Source of variation	Sum of squares	df	Mean square	Test statistic	P-value
Measuring time	255.058	2.129	119.829	174.286	0.000
Interactional effect of measuring time and groups	152.947	2.264	67.553	98.997	0.000
Error	105.058	153.959	0.682		

The Greenhouse-Geisser test results show that there exists a significant increase in the average inflation rate during four phases of postoperative measurement ($p < 0.001$). In addition to the total sample, this increase in the inflation rate is also observed in each of the individual groups. The test results indicate an interactional effect between measuring time and the experimental group. The level of significance in this case is nearly zero. Therefore, it is concluded that there is a significant effect between measuring time and the groups. To this end, the inflammatory rate was not the same in the both groups meaning that it is higher in the control group. It could be stated that peri- and post-operative cryotherapy can significantly reduce the amount of edema resulted from rhinoplasty surgery.

DISCUSSION

With the popularity of beauty surgeries, many surgeons are willing to reduce postoperative edema in their patients. To diminish this problem, various steroidal and non-steroidal anti-inflammatory drugs (NSAIDs) are used. In the long term, steroidal and non-steroidal drugs can lead to complications. Due to the wide range of physiological impacts of drugs, doctors have constantly been looking for safer methods to reduce postoperative edemas. One of these safe methods is called cryotherapy. Currently, cryotherapy – known as cold and ice therapy – has been demonstrated to be effective after traumatic surgeries and in the treatment of soft tissue injuries [25]. Cryotherapy improves edema and inflammatory reactions and is influential in reducing the inflammatory response without inhibiting the blood flow after contusion. The underlying mechanism of cryotherapy operates in a way to reduce tissue-temperature as well as the perception of pain, muscle spasms, and metabolism of the body. The second effect of cryotherapy is to minimize any associated inflammatory process, resulting in the recovery of soft kantos injuries. In addition, cryotherapy has been promoted in immediate care and rehabilitation [26]. The present study was an attempt to identify the effect of cryotherapy on the reduction of nasal edema and periorbital ecchymosis in patients undergoing rhinoplasty surgery.

Studying the effects of cryotherapy on the immune system, it was appeared that the increased level of white blood cells in response to a series of 10 stimulations caused by a 30-minute whole body cryotherapy at 130 °C leads to an increase in the level of IL-6 of the immune system; and continued cryotherapy stimulations results in increased levels of anti-inflammatory cytokines of IL-6, 10 and 12 over a full range of stimulations. This study proposed cryotherapy as a great influence in inflammatory reduction. . In patients with inflammatory rheumatic disease, based on Cryotherapy for pain and inflammation in rheumatic disease or to improve the functioning of the body is used. In this study 20 patients with rheumatoid arthritis and osteoarthritis Cryotherapy entire body with a temperature of 140 to 160 Santy-Grad degrees for 2 to 3 minutes, once a day for 4 weeks. For the first time, cryotherapy significantly reduced histamine led. Histamine levels in the blood of patients with rheumatoid arthritis long-term (minimum 3 months). Also, the effect of whole-body cryotherapy to eliminate pain and inflammation in rheumatoid arthritis showed. Due to the differences in the two groups of trauma or surgery to reduce inflammation after rhinoplasty Cryotherapy rhinoplasty surgery, the difference was statistically significant. This finding suggests that the effects of cold to reduce inflammation after rhinoplasty surgery in the intervention group compared with the control group [27].

In like manner, the effect of cryotherapy on postoperative complications of third-molar extraction surgery and observing randomized clinical ramifications of the eyes and mouth was examined in the University of Tabriz. In this study, the patients immediately received a 25-minute cryotherapy postoperatively and for 24 hours thereafter on both sides of their jaws. The findings demonstrated that ice packs result in temperature drop, tissue metabolism and blood flow to the damaged or surgical site eventuating in the reduction of pain and inflammation. Besides, cryotherapy increases the survival of tissues by reducing chemical reactions and oxygen demand in the surgical site. It also revealed that cryotherapy greatly reduces the inflation of the lockjaw muscle and facial inflammation after surgery. This method not only reduces anti-inflammatory and analgesic drug use but also leads to savings and accelerated recovery process. In other words, the treatment was conventionally pursued without the use of any medication [28].

The clinical rationale for the use of cryotherapy focuses on controlling pain, negative effects on inflammation and other skeletal and muscular trauma. Physiological and clinical evidences indicate that coldness is used for the reduction of nerve conduction velocity, localized blood flow and also reduction of cellular metabolic rate. These effects, in turn, reduce the inflammatory response to trauma, pain reduction, edema formation, and delay in reducing secondary hypoxic injury.

A study on the effectiveness of cryotherapy in knee joint position sense showed that cryotherapy prior to knee exercises is to minimize inflammation and it also insures the person to resume the exercise without pain. In this study, a 20-minute cryotherapy in the knee joint position reduces knee injuries during instant exercises [29]. This finding is consistent with the results reported in the present paper.

In a similar vein, a research study was conducted in Honesty Ashram Hospital on preventing and reducing pain, ecchymosis and hematoma at the subcutaneous heparin injection site using wet ice bags. It was found that using wet ice bag is greatly effective in preventing and reducing bruising, pain and hematoma at the heparin injection site. In fact, while being associated with a decrease in temperature, the wet ice bag reduces the physiological responses of the damaged tissue cells at the injection site. Clinical application of cryotherapy is highlighted in the trauma that primarily leads to contraction resulting in the reduction of edema and hemorrhage at the site of the injury. This study focused on the reduction of hematoma which is in agreement with the results reported on the effectiveness of coldness in hematomas developed after rhinoplasty [30].

CONCLUSION

In conclusion, the current study revealed that coldness is effective in the reduction of edema and ecchymosis and develops fewer complications than the systemic inflammatory reducing drugs. According to this study and the absence of any complications within the specified time intervals as well as its ease of use and not having the problems associated with drug injection, cryotherapy could be used postoperatively as an alternative to steroidal and non-steroidal systematic and topical anti-inflammatory drugs in patients undergoing rhinoplasty; and even in other cases after muscle and skeletal trauma.

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