TECHNOLOGY REVIEW (MINI-HTA)

FAR INFRARED THERAPY FOR ARTERIOVENOUS FISTULAS AND WOUND HEALING

Malaysian Health Technology Assessment Section (MaHTAS)
Medical Development Division
Ministry of Health Malaysia
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EXECUTIVE SUMMARY

Background

Patients with end-stage renal disease are required to undergo haemodialysis treatments or a kidney transplant for survival. In patients undergoing haemodialysis renal replacement, the vascular access must be well-maintained for long-term treatment. Even though arteriovenous (AV) fistula is an excellent option for the successful long-term access, however the cumulative incidence of loss of AV fistula patency demonstrated an increasing trend. At present, treatment of loss of AV fistula patency mainly includes percutaneous, thrombectomy or surgical procedures. While there are positive effects of these treatments, the evidence does not focus on the immature fistula preservation and only assess on short-term duration of efficacy. Moreover, in terms of wound healing, slow rate of healing is associated with a reduction in blood flow due to total or partial obstruction, or known as vascular occlusion. A vascular blockage of blood vessel supplying the skin can cause tissue death and skin necrosis if treatment is not received. Several conventional methods to overcome the above medical issues have some limitations. Hence, attention has focused on far infrared therapy as an alternative. This therapy involves electromagnetic wave penetrates through skin into subcutaneous tissues at a specified energy setting for a predetermined number of sessions for a set treatment duration and number of treatments. While its mechanism of action is still not completely clarified, the far infrared energy is believed to resonate with cellular frequencies and interact with biological structure. This relieve pain and activate immune response. Given the lack of clarity surrounding far infrared therapy, and the expanding number of practitioners who are offering the service, this technology review was requested by the Department of Plastic Surgery and Reconstructive, Hospital Melaka to evaluate the potential of far infrared therapy as an alternative to standard treatment for AV fistulas and wound healing in Malaysia.

Objective/aim

The objective of this technology review was to assess the effectiveness, safety and economic implication of far infrared therapy as a treatment option for patients with AV fistulas and wound.

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Results and conclusions

The initial searches yield a total of 580 citations. After assessing for eligibility criteria, five full text articles were subsequently retrieved and included in the review, which consists of one systematic review and meta-analysis, one randomised controlled trial, one non-randomised experimental trial, one cohort study and one experimental study. The studies were conducted in Sweden, Korea, China and Indonesia.

Effectiveness:

There was limited and fair level of retrievable evidence to suggest far infrared therapy improved AV fistulas function and wound healing regarding patient-subjective outcomes relative to those who received placebo/ rehab program/ iodine control treatment. Findings in general indicated that:

i. Far infrared therapy improved vascular access flow levels ($p<0.001$), AV fistulas diameter ($p<0.001$) and primary patency rates ($p<0.001$).

ii. Far infrared therapy reduced the incidence of AV fistula occlusion ($p<0.001$) and needling discomfort ($p<0.001$

iii. Far infrared therapy increased blood velocity over the fistula from mean 2.1 ms^{-1} (±1.0) to 2.3 ms^{-1} (±1.0); $p=0.02$ and venous diameter from 0.7 cm (±0.2) to 0.8 cm (±0.2), $p=0.006$.

iv. Fistula blood velocity and base line serum-urate correlated positively ($r_o=0.52$, $p=0.004$).

v. Venous diameter and base line orosomucoid levels correlated significantly ($r_o=0.51$, $p=0.005$).

vi. Far infrared therapy decreased visual analogue scale (VAS) at five weeks (1.7±1.0 vs. 2.8±1.4, $p=0.002$) and three months (2.4±1.3 vs. 3.2±1.8, $p=0.041$).

vii. Far infrared therapy emissivity correlated significantly with skin blood perfusion ($r=0.81$).

viii. HaCat and Huvec in far infrared therapy group proliferated better.

ix. Far infrared therapy demonstrated larger healing area in the HaCat and Huvec.

x. Far infrared therapy improved redness, oedema, ecchymosis, discharge and approximation (REEDA) scale on both groups from day 1 to day 2 ($p=0.00$), and on far infrared group from day 2 to day 3 ($p=0.04$).

Safety:
There was limited and fair level of retrievable evidence suggesting that far infrared therapy was generally safe with no incidence of adverse events and well-tolerated by patients during the treatment of AV fistulas and wound healing. Overall, studies reported that far infrared therapy was not associated with skin burn, infection, wound problem, hypersensitivity reaction and body temperature elevation during the sessions or the follow up. However, the United States of Food and Drug Administration (USFDA) only has approved far infrared therapy as a treatment for muscle and joint pain/ stiffness.

Economic implication:
There was no retrievable evidence on cost-effectiveness of far infrared therapy for treating AV fistulas and wound healing. The global market and Malaysian far infrared device prices differ, as do their levels of advancement.

Organisational:
There are several international organisations that have published statement/ guideline recommendations surrounding far infrared therapy including International

Commission on Non-ionising Radiation Protection (ICNIRP; 2006) and European Renal Associations – European Dialysis and Transplant Associations and Nephrology Dialysis Transplantation (ERA-EDTA; 2019). The statement updated on the guideline of far infrared utilisation, especially on several patients with chronic/ unstable condition. This therapy is also recommended for AV fistulas maturation and long-term maintenance of AV fistulas patency.

Conclusion:
There was limited evidence of far infrared therapy for patients with AV fistula and its usage for wound healing. The evidence showed fair improvement in AV fistulas functions, wound healing rate and pain, and the effect might last up to six to 12 months. Up to three months after surgery, adjuvant daily therapy and rehabilitation exercises reduced post-surgical wound pain. In terms of safety, the evidence demonstrated that the technology is a safe and well-tolerated treatment. In contrast, although it has been recommended for AV fistulas maturation and long-term maintenance of AV fistulas patency, it is still being investigated and has not yet received USFDA approval as a therapy option.

Methods
A systematic review was conducted. Review protocol, search strategy and literature search was developed by the main author related to far infrared therapy for the treatment of AV fistula function and wound healing. The following electronic databases were searched through the Ovid interface: MEDLINE® All <1946 to 1st March 2024. Comparative searches were run in PubMed, USFDA and INAHTA database while further articles were retrieved from reviewing the bibliographies of retrieved articles. Only articles on humans were included in the review. There was no language restriction in the search. The most recent search was carried out on 5th March 2024.

TABLE OF CONTENTS

ABBREVIATIONS

AV	Arteriovenous
CASP	Critical Appraisal Skills Programme
CI	Confidence interval
DNA	Deoxyribonucleic acid
ERA-EDTA	European Renal Associations – European Dialysis and Transplant Associations and Nephrology Dialysis Transplantation
ICNIRP	International Commission on Non-ionising Radiation Protection
MD	Mean deviation
REEDA	Redness, oedema, ecchymosis, discharge and approximation
RoB	Risk of bias
USFDA	United States of Food and Drug Administration
VAS	Visual analogue scale

1.0 BACKGROUND

Chronic kidney disease affects 14.9% of the United States population overall; the two subpopulations with the highest prevalence are individuals over 65 (38.6%) and females (16.0%).[1] Meanwhile in Malaysia, the prevalence of chronic kidney disease increased to 15.5% in 2018 from 9.1% in 2011.[2] The patients with end-stage renal disease are required to undergo dialysis. Renal transplant or haemodialysis are not the only options for survival. Patients on haemodialysis patients typically require three to five treatments each week. The effectiveness of haemodialysis is directly related to the quality and consistency of the vascular access.[3] More than 80.0% of patients begin haemodialysis with a central venous catheter, which is associated with risk of infection especially in long-term use.[4,5]

Vascular access must be effective and well-maintained for long-term haemodialysis treatment. Thus, establishment of a surgical AV fistula is an excellent option **(see Figure 1)**.[6] Since the number of patients with end-stage renal disease is constantly rising, therefore AV fistulas will remain a vital and useful procedure in the years to come. Unfortunately, the cumulative incidence of loss of AV fistulas patency demonstrated an increasing pattern from 2017 to 2019; 40.9% for primary unassisted patency, 15.1% for primary assisted patency, and 2.4% for secondary patency.[7] Several studies have emphasised that the majority of these failed fistula can be salvaged using percutaneous technique such as predominantly balloon angioplasty (arterial and/or venous). Thrombectomy procedures also may be necessary on occasion to preserve these fistulas. In addition, surgical treatments including reanastomosis, revision utilising vein interposition or patch angioplasty, hybrid creation using a prosthetic segment, or superficialisation will be required if percutaneous procedures fail. However, the salvage of immature fistula has not been the focus of these studies.[8]

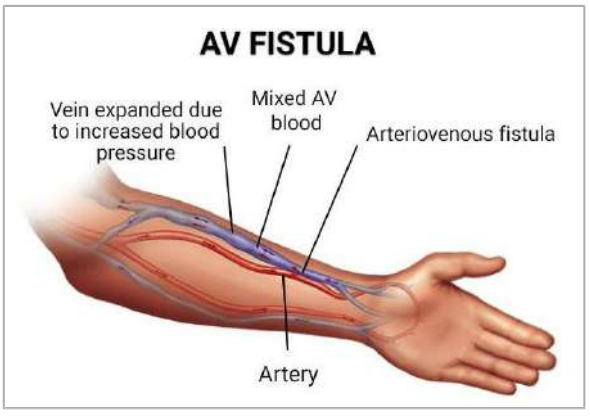


Figure 1: The patient's arm is operated on by a vascular specialist to create an arteriovenous fistula, which allows blood to flow from an artery straight into the vein. The fistula access procedure should ideally be performed approximately six months prior to the initial dialysis session.[9]

In terms of wound healing, wounds heal in four to six weeks generally. Wounds that take longer than this to heal are considered chronic. Impaired healing can be caused by various circumstances. Hypoxia, bacterial colonisation, ischaemia, reperfusion injury, modified cellular response and abnormalities in collagen synthesis are the

main contributing causes. These could be brought on by chronic illnesses like smoking or malnutrition or systemic diseases like diabetes. Localised conditions such as pressure, tissue oedema, hypoxia, infection, maceration and dehydration can hinder the healing of wounds.[10]

Prediction and prevention of uncomfortable pain are particularly important during the early post-operative and wound healing period, as such pain can result in continued decrease in function. Impaired-healing wounds **(see Figure 2)**, such as delayed acute wounds and chronic wounds, typically have not healed through the stages that are expected to occur. These wounds often progress into a pathologic inflammatory state as a result of a delayed, inefficient or disorganised healing process. In the United States, three to six million people suffer from non-healing wounds; 85.0% of these cases involve individuals more than 65 years of age or older. Non-healing wounds result in enormous health care expenditures, with the total cost estimated at more than USD 3 billion per year.[11,12]

Figure 2: Example of impaired-healing wound. Tissue defect closed with *a. radialis* free flap before (left) and after (right) microvascular flap thrombosis.[13]

Clinical considerations in wound management include treating oedema, avoiding more damage, keeping the wound adequately moist and, preventing infection and contamination. Wounds can be cleaned by scrubbing and irrigating with a 0.9% saline solution. However, that infection rates for wounds irrigated with tap water were found to be comparable to those irrigated by a 0.9% saline solution.[14] Recently, the goal of current wound healing research is to find target genes at the molecular level that can be improved to expedite natural wound process. A multimodal approach that emphasises appropriate dressing and local care, nutritional support and hyperbaric oxygen therapy in severe cases is required to ensure good wound healing in the most challenging cases.[15]

Recently, thermal therapy using far infrared therapy has been proposed for health conditions **(see Figure 3).** According to claims, it has positive effects on enhancing blood circulation, which helps AV fistulas mature and serves the dual purposes of accelerating wound healing and vascular access blood flow.[16] In addition, the electromagnetic wave demonstrated a good penetration power through skin into subcutaneous tissues, which helps to reduce discomfort, relieve pain and fatigue, supply more oxygen to the body and activate the immune response.[17] Although the number of studies has increased in recent years, the results have been fairly inconsistent, and there have always been difficulties in interpreting treatment outcomes due to variations in patient populations and treatment protocols.

Figure 3: Far infrared therapy is a convenient, non-invasive physical therapy that carries on the Omni-directional care to haemodialysis patients' vascular access.[18]

Given the lack of clarity surrounding the effectiveness of far infrared therapy, this technology review was requested by the Department of Plastic Surgery and Reconstructive, Hospital Melaka to evaluate whether far infrared therapy can be used as an alternative to standard treatment for AV fistulas and wound healing in Malaysia.

2.0 OBJECTIVE/ AIM

The objective of this technology review was to assess the effectiveness, safety and economic implication of far infrared therapy as a treatment option for patients with AV fistulas and wound.

3.0 TECHNICAL FEATURES

The infrared radiation band as shown in **Figure 4** spans the entire electromagnetic radiation spectrum, with wavelengths between 750 nm and 100 μm, frequencies between 400 THz and 3 THz, and photon energies between 12.4 meV and 1.7 eV. It is located between the visible spectrum's long wavelength red edge and the terahertz (beginning at 3 THz) spectrum's short edge. The classification provided in ISO 20473 standard for the sub-division of the infrared ranges is given in **Table 1**.[18] In the infrared radiation bands, only far infrared transfers energy purely in the form of heat which can be perceived by the thermoreceptors in human skin as radiant heat.[19] The human body not only absorbs far infrared, but it also emits as black body radiation, which has an output peak at 9.4 μm and ranges from 3 to 50 μm.[18]

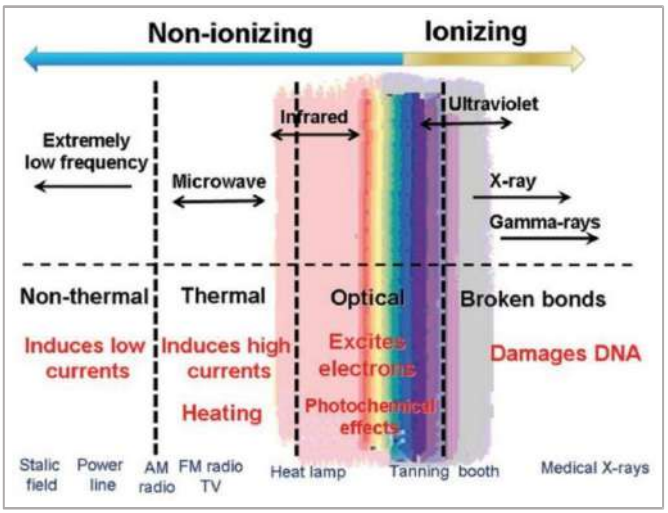


Figure 4: The spectrum of electromagnetic radiation and some biological changes it may induce.[18]

Table 1: ISO 20473 standard for sub-division of the infrared.[18]

Name	Wavelength (μm)
Near infrared	0.78 – 3.00
Mid infrared	3.00 – 50.00
Far infrared	50.00 – 1000.00

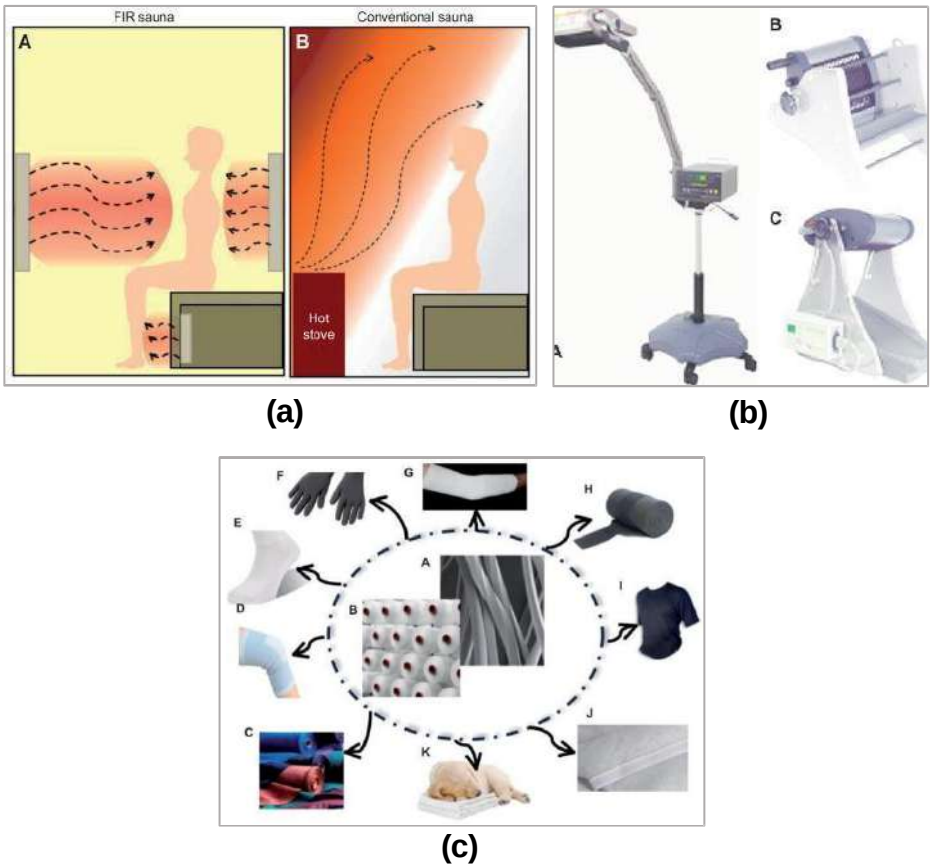
Understanding and knowledge of how electromagnetic radiation interacts with biological structures (such as cells, cell membranes, cell fluids, particularly water, deoxyribonucleic acid [DNA] and proteins), as well as the basic functioning of living systems, are necessary for the application of far infrared in medicine. The fundamental biophysical mechanisms of electromagnetic radiation's interaction with live cells can be understood at the cellular level in terms of modified cell membrane potentials and altered mitochondrial metabolism. The names ‘biogenetic radiation’ and ‘biogenetic rays’ have been coined and are commonly used in popular publications to refer to far infrared utilised as a therapy technique. Although the far infrared wavelength is too long for human vision, the body may feel its energy as a mild radiant heat that can reach to a depth of as four cm beneath the skin's surface. Far infrared energy is sufficient to resonate with cellular frequencies and impose rotational and vibrational modes of motion in the bonds that create molecules, including water molecules. When the skin is exposed to far infrared radiation, the resulting epidermal temperature is higher than when equal thermal loads from shorter wavelengths are employed.[18]

There are three main techniques for far infrared radiation delivery:[18]

- **Far infrared sauna:** As shown in **Figure 5a**, the temperature of the cabin air is normally 40°C or lower, and the heating elements in these cabins are typically heated to between 300°C and 400°C. This shows that the emission is in the far infrared region, meaning that the heat exchange between the body and the environment is virtually entirely radiative (radiant heating). Compared to traditional saunas, far infrared warming chambers heat the skin more quickly, yet, greater skin irradiation is required to induce noticeable sweating.

- **Far infrared ray devices:** Several literatures show that far infrared emitters are used to treat allergic rhinitis, vascular access malfunction with an inadequate access flow in hemodialysis patients and muscle damage. The device as shown in **Figure 5b** is placed 30 cm to 40 cm from the affected area and the treatment is performed for 40 minutes for respective days (which is decided by therapist).

- **Far infrared emitting ceramics and fabrics:** Discs and garments manufactured of far infrared emitting ceramic material have been applied to the human body **(see Figure 5c)**.



(a) **(b)**

(c)

Figure 5: Techniques to deliver far infrared radiation.[19]

4.0 METHODS

A systematic review was conducted. Search strategy was developed by the main author and reviewed by the co-author.

4.1 Searching

The following electronic databases were searched through the Ovid interface:

- Ovid MEDLINE® All <1946 to 1st March 2024>

Other databases: PubMed, USFDA, INAHTA

General databases such as Google Scholar was used to search for additional web-based materials and information. Additional articles retrieved from reviewing the bibliographies of retrieved articles. The search was limited to articles on human. There was no language limitation in the search. **Appendix 1** shows the detailed search strategies and the last search was conducted on 5th March 2024.

4.2 Selection

A reviewer screened the titles and abstracts against the inclusion and exclusion criteria. The risk of bias for the included studies were assessed according to the criteria outlined in the ROBIS, Cochrane Risk of Bias (RoB 2.0), ROBINS-I and Critical Appraisal Skills Programme (CASP) checklists. P-values less than 5.0% were considered as statistically significant. Studies were graded according to US/ Canadian Preventive Services Task Force **(Appendix 2)**. All data were extracted and summarised in evidence tables as in **Appendix 3**.

The inclusion and exclusion criteria were:

Inclusion criteria:

Population	Patients with arteriovenous fistulas or wound
Interventions	Far infrared therapy
Comparators	Conventional therapy
Outcomes	**Effectiveness:** Improvement in arteriovenous fistulas maturation and vascular access, wound healing rate, pain intensity **Safety:** Adverse events related to treatment **Economic implication:** Cost
Study design	Health Technology Assessment reports, Systematic Review and Meta-Analysis, Randomised Control Trial, Non-randomised Control Trial, cohort studies, cross-sectional studies, case studies
Type of publication	Full text articles published in English

Exclusion criteria:

Study design	Animal studies, narrative reviews
Type of publication	Non-English full text articles

5.0 RESULTS

5.1 Selection of the included studies

The results of the study selection process are summarised in the PRISMA flow diagram in **Figure 6**. The initial searches yield a total of 580 citations from electronic database and 15 from Google Scholars, with 284 citations remaining following removal of duplicates. The titles of these citations were screened with a total of 31 titles deemed potentially relevant. The abstracts of those titles were examined and 25 full text articles were successively retrieved. Five full articles were included after assessing for eligibility criteria, which consists of one systematic review and meta-analysis, one randomised controlled trial, one non-randomised experimental trial, one cohort study and one experimental study. The studies were conducted in Sweden, Korea, China and Indonesia.

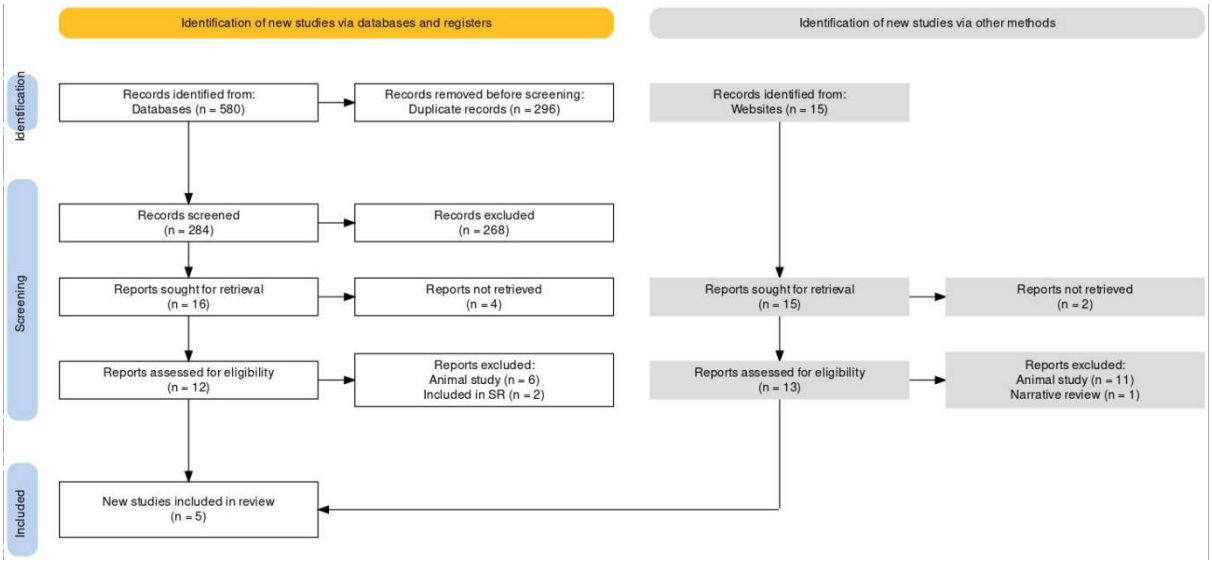


Figure 6: PRISMA 2020 flow diagram.[21]

5.2 Critical appraisal of the included studies

The systematic review with meta-analysis was appraised using ROBIS. There was no information on the efforts made in minimising error in selection of studies. This resulted an unclear concern regarding methods used to identify and select studies **(see Figure 7)**.[22, level I] Meanwhile, Cochrane RoB 2.0 checklist was utilised to assess the quality of the randomised controlled trial **(Figure 8)**. The study showed some concerns on randomisation process as there was no information on the allocation sequence concealed for participants prior to the treatment.[23, level I] The ROBINS-I **(see Figure 9)** was used to critically appraised the non-randomised experimental study. There was a moderate judgement on the outcomes measurement; since iodine treatment was used in the control group, the assessors might not able to be blinded due to the stain colour of the iodine residue on the patients' skin.[24, level II-I] Based on the CASP checklist, the study showed unclear information on the follow up period **(see Figure 10)**.[23]

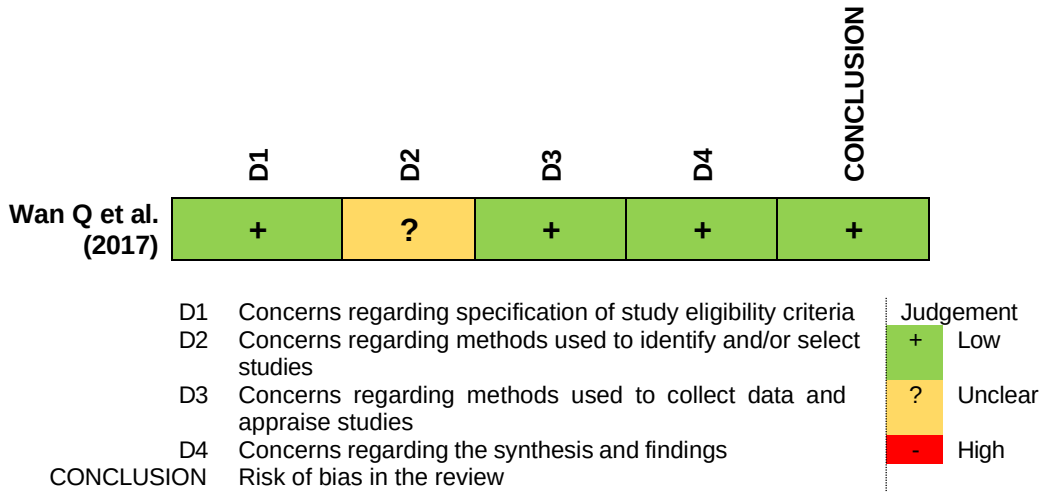


Figure 7: Quality assessment of systematic review by using ROBIS.

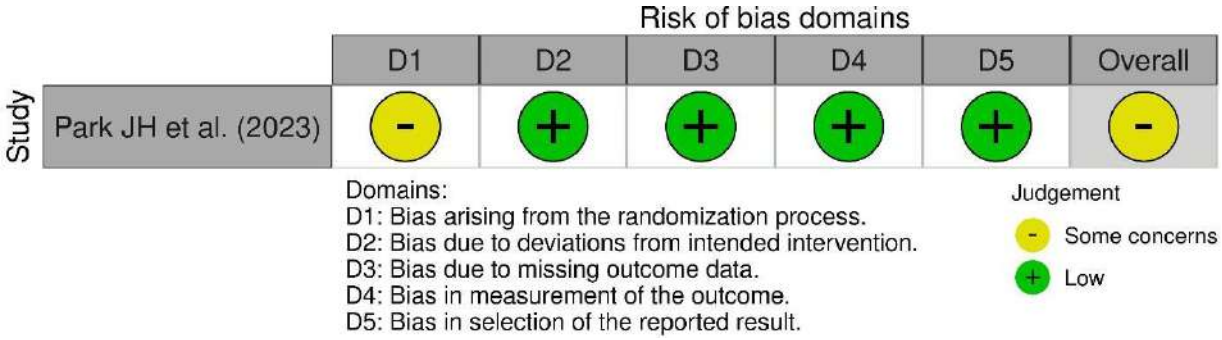


Figure 8: Quality assessment of randomised controlled trial by using Cochrane Risk of Bias 2.0.

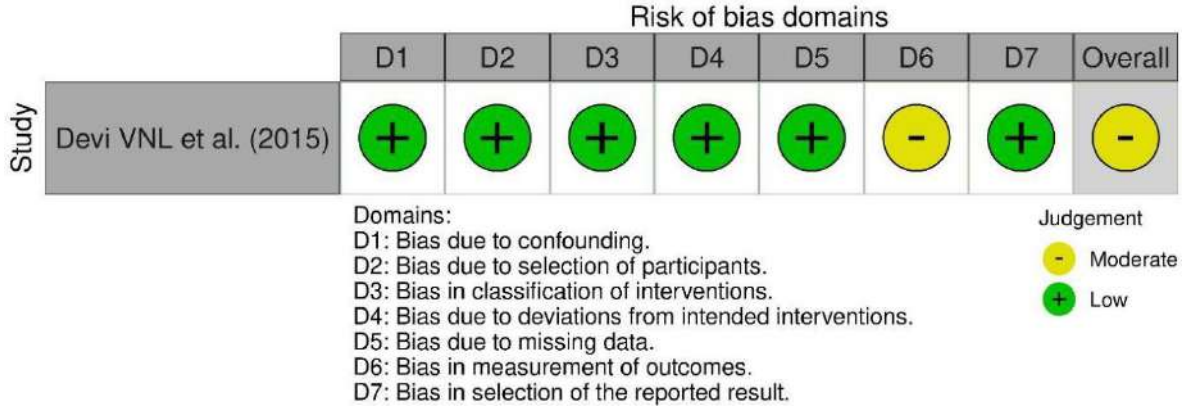


Figure 9: Quality assessment of non-randomised experimental study by using ROBINS-I.

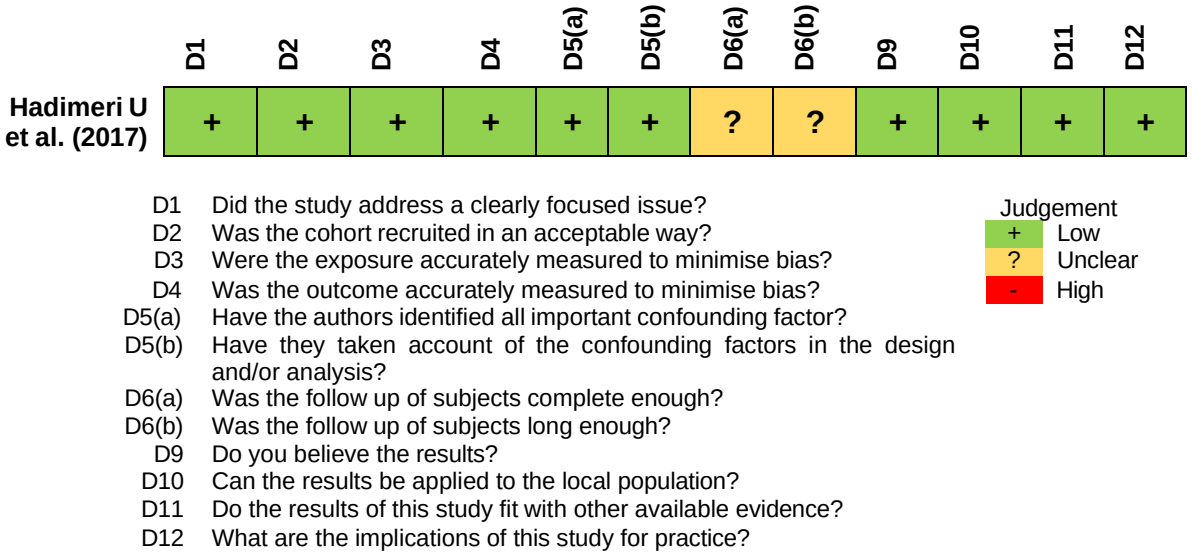


Figure 10: Quality assessment of cohort study by using CASP.

5.3 Effectiveness

5.3.1 Far infrared therapy on AV fistula function

A systematic review of the evidence regarding far infrared therapy for patients who underwent AV fistula surgeries was undertaken with a meta-analysis by Wan Q et al. (2017) to assess the efficacy of the treatment modality. A total of 21 studies involving 1,899 haemodialysis patients (mean age ranged from 41.8 to 71.4 years; 960 were treated with far infrared therapy, 939 with placebo) were included. These studies were performed by different medical centres in different countries. The overall meta-analysis of the data revealed that vascular access flow levels were significantly higher in the far infrared group than in the control group (mean deviation [MD] 81.69 mL/min; 95% CI: 46.17 to 117.21; $p<0.001$), with significant heterogeneity between studies ($p=0.00001$; $I^2=86.0\%$) **(see Figure 11)**. Meanwhile in the subgroup analysis on different duration terms, the data showed there was no different effect on vascular access blood flow level among trials.[22, level I]

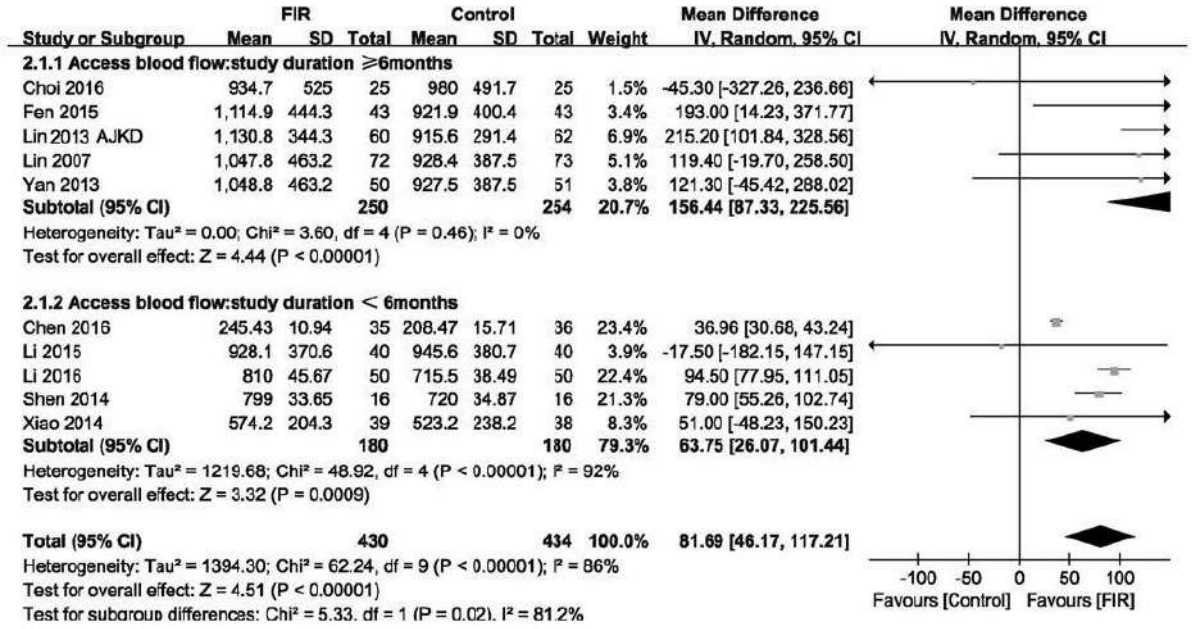


Figure 11: Forest plot of studies comparing the effect of far infrared therapy versus placebo on vascular access blood flow in haemodialysis patients.[22, level I]

Five trials (n=381) evaluated the impact of far infrared therapy on the diameter of AV fistulas. According to the pooled analysis results in **Figure 12**, a significant increase in AV fistulas diameter level was observed in far infrared group as compared to the control group (MD 0.36 mm; 95% CI: 0.22 to 0.51; p<0.001) as well as an evidence of heterogeneity (p=0.01; I^2=68.0%).[22, level I]

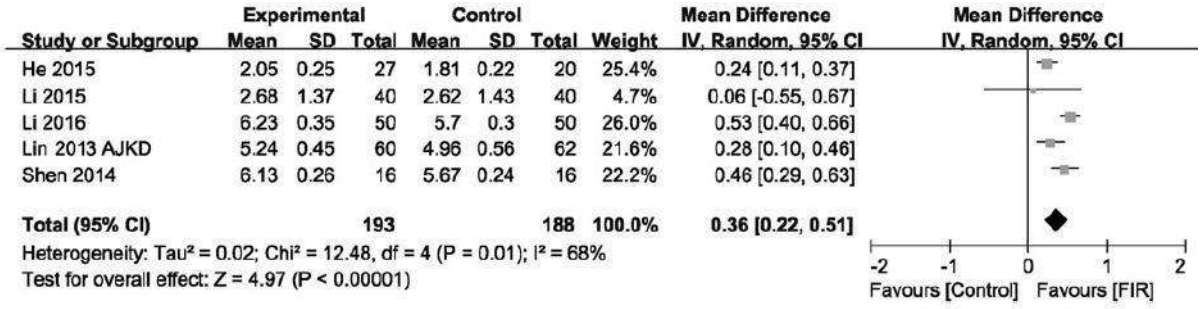


Figure 12: Forest plot of studies comparing the effect of far infrared therapy versus placebo on arteriovenous fistula diameter in haemodialysis patients.[22, level I]

Four trials were included in the meta-analysis to evaluate the impact of far infrared therapy on the patency of primary AV fistulas at a 12-month mark. The results revealed a significant difference between the two groups, with the far infrared group exhibiting better primary patency rates than the control group (risk ratio [RR] 1.24; 95% CI: 1.12 to 1.37, p<0.001); no statistical heterogeneity was found (p=0.96; I^2=0.0%). Furthermore, results regarding the occlusion rates of AV fistulas were presented for five studies with 510 participants. Overall, compared to the control group, therapy with far infrared radiation reduced the incidence of AV fistula occlusion (RR 0.20; 95% CI: 0.08 to 0.46, p<0.001) with no evidence of heterogeneity (p=0.84, I^2=0.0%). Besides that, patients' level of needling pain was

also assessed in three trials by using a numerical rating system. When comparing the groups getting far infrared therapy to the control group not receiving the treatment, the pooled analysis result revealed that the needling discomfort decreased significantly (RR 0.08; 95% CI: 0.06 to 0.10, p<0.001). However, the result has to be interpreted with caution as the study was heterogenous (p<0.00001; I^2=99.0%).[22, level I]

Hadimeri U et al. (2017) investigated whether a far infrared therapy could alter blood velocity and AV fistula. Thirty patients with a native AV fistula in the forearm were examined. The AV fistula was assessed using ultrasound both prior to and following a single far infrared therapy. The patient underwent ultrasound measurements while in a supine posture, and the distal portion of the upper arm's veins were examined along with the wrist to determine the location of the AV fistula. Following the ultrasonic examination, a 40-minute far infrared treatment was administered at a height of 25 cm above the skin's surface across the region containing the designated sites. Blood pressure was taken and fresh blood was drawn right after the last treatment. Significant improvements of far infrared therapy were demonstrated on blood velocity over the fistula from a mean of 2.1 ms^{-1} (±1.0) to 2.3 ms^{-1} (±1.0); p=0.02 and venous diameter (from 0.7 cm [±0.2] to 0.8 cm [±0.2], p=0.006). There was also a positive correlation between the increase in fistula blood velocity and base line serum-urate (r_o=0.52, p=0.004), as well as a positive correlation between the increase in venous diameter and base line orosomucoid levels (r_o =0.51, p=0.005). Conversely, AV fistula blood velocity change following far infrared scans did not correlate with age, blood haemoglobin, erythropoiesis stimulating agent dosage, baseline systolic or diastolic blood pressure, mean arterial pressure or LDL-cholesterol. The study also showed the change in blood velocity or diameter of the arterial, fistula or venous part of the AV fistula did not differ between patients with or without diabetes mellitus, those who were or were not receiving haemodialysis, statins or anticoagulants or between men and women.[25, level II-2]

5.3.2 Far infrared therapy on wound healing

A randomised controlled trial by Park JH et al. (2023) evaluated the effects of post-operatively applied far infrared with regard to early pain, range of motion and tendon-to-bone healing after arthroscopic rotator cuff repair. The 64 consecutive patients who had arthroscopic rotator cuff repair performed between November 2019 and June 2020 were enrolled, with mean age of 59.7±9.4 years (range from 38 to 76 years). From the first post-operative day, the far infrared therapy group (n=31) received two sessions of thirty minutes each by using a radiator device situated between 30 cm and 35 cm away from the patient's skin. Ten weeks were allotted to this application during the recovery phase. Meanwhile, the control group (n=33) received no far infrared therapy. Other rehabilitation programs were done in the same manner as those of the far infrared group. The far infrared group showed significant lower visual analogue scale (VAS) as compared to control group at five weeks (1.7±1.0 vs. 2.8±1.4, p=0.002) and three months (2.4±1.3 vs. 3.2±1.8, p=0.041) post-operatively. However, there were no significant differences in VAS between the two groups at the six months follow up. Regarding anatomical healing which was evaluated by magnetic resonance imaging at six months after surgery, there was also no significant difference between the two groups; only one (3.2%) healing failure happened in the far infrared group.[23, level I]

There has been no study of this therapy at the cellular level. Herein, Mu Y et al. (2020) designed an experimental study to explore the effects of different fabrics of far infrared on HaCat (immortalised human keratinocytes, which are widely employed in research on the pathophysiology and maintenance of epidermal homeostasis) and venous endothelial cells; the human umbilical vein endothelial cells (Huvec). By combining the four types of far infrared nanoparticles (tea carbon fibre, bamboo charcoal fibre, coffee carbon fibre and graphene fiber) into the polymer polymerisation process, hence four types of high-emissivity far infrared polyamide fibres were produced. The plastic cell culture plates were coated with the four types of textiles and the cells were exposed to varying durations of continuous far infrared light for a period ranging from zero to 12 days. Meanwhile, the experimental control group in the cell proliferation experiment did not receive any far infrared radiation. The study presented data as below:[26]

- The Person correlation coefficient between the fabrics far infrared emissivity and skin blood perfusion was r=0.81 (when r>0.80, the relationship was verified). Thus, in a given range, the promotion of skin blood circulation was more substantial the higher the far infrared emissivity.
- The proliferation curve demonstrated that HaCaT and Huvec in the far infrared groups were more proliferative than in the control group. As compared to control group, the HaCat on tea carbon fibre showed the best ability to proliferate (p=0.011), followed by bamboo charcoal fibre (p=0.013) and coffee carbon fibre (p=0.030). Meanwhile, the data in Huvec presented tea (p=0.014) and coffee carbon fibre (p=0.016) had the strongest proliferation ability when compared to control group.
- Within 24 hours, the healing area in the HaCat and Huvec in the far infrared group was significant larger than in the control group; the tea carbon fibre group appeared the most significant when compared to control, p<0.05).

In a non-randomised experimental study by Dewi VNL et al. (2015), 30 female adults aged from 20 to 30 years old, and suffered lacerations in perineum were located in far infrared and iodine group. The perineum's healing was evaluated using the REEDA scale; 0 indicates no infection, 15 shows most severe infection. For ten minutes, the first fifteen postpartum patients had 45 cm of infrared light sutured to their perineum. In the meantime, iodine was given to the next fifteen postpartum patients once a day. The results indicated significant difference (p=0.00) in the control group only from day one to day two. Meanwhile, the intervention group also demonstrated a significant improvement from day one to day two (p=0.00) and from day two to day three (p=0.04).[24, level II-I]

Table 2: A summary of effectiveness of far infrared therapy for the treatment of arteriovenous fistula function and wound healing.

Study	Patient characteristic	Follow up duration	Intervention		Findings
			Treatment	Control	
Patients with AV fistula					
Wan Q et al. 2017 SR & MA[22]	1,899 Haemodialysis patients	3 weeks to 12 months	FIR	Placebo	• FIR improved vascular access flow levels (MD 81.69 mL/min; 95% CI: 46.17 to 117.21; p<0.001); I^2=86.0%). • FIR increased the AV fistulas diameter (MD 0.36 mm; 95% CI: 0.22 to 0.51; p<0.001; I^2=68.0%). • FIR exhibited better primary patency rates (RR 1.24; 95% CI: 1.12 to 1.37, p<0.001). • FIR reduced the incidence of AV fistula occlusion (RR 0.20; 95% CI: 0.08 to 0.46, p<0.001). • FIR decreased needling discomfort (RR 0.08; 95% CI: 0.06 to 0.10, p<0.001; I^2=99.0%).
Hadimeri U et al. 2017 Prospective cohort study[25]	30 Haemodialysis patients, treated with peritoneal dialysis, no regular dialysis	NI	FIR	NI	• FIR improved blood velocity over the fistula from mean 2.1 ms^{-1} (±1.0) to 2.3 ms^{-1} (±1.0); p=0.02 and venous diameter from 0.7 cm (±0.2) to 0.8 cm (±0.2), p=0.006). • Fistula blood velocity and base line serum-urate correlated positively (r_o=0.52, p=0.004). • Venous diameter and base line orosomucoid levels correlated significantly (r_o=0.51, p=0.005).
Wound healing for patients					
Park JH et al. 2023 RCT[23]	65 Patients with arthroscopic rotator cuff repair	5 weeks, 3 and 6 months	FIR + rehab program	Rehab program	• FIR decreased VAS at 5 weeks (1.7±1.0 vs. 2.8 ± 1.4, p=0.002) and 3 months (2.4±1.3 vs. 3.2±1.8, p=0.041).
Mu Y et al. 2020 Experimental study[26]	HaCat and Huvec	NI	FIR	No treatment	• FIR emissivity correlated significantly with skin blood perfusion (r=0.81). • HaCat and Huvec in FIR group proliferated better. • FIR demonstrated larger healing area in the HaCat and Huvec.
Dewi VNL et al. 2015 Non-randomised experimental study[24]	30 Lacerations in perinium	1, 2 and 3 days	FIR	Iodine	• Both groups showed improvements in REEDA scale from day 1 to day 2 (p=0.00). • FIR group showed an improvement in REEDA scale from day 2 to day 3 (p=0.04).

SR & MA, Systematic review & meta-analysis; FIR, far infrared; MD, mean difference; CI, confidence interval; AV, arteriovenous; RR, risk ratio; NI, no information; RCT, randomised controlled trial; VAS, visual analogue scale; REEDA, redness, oedema, ecchymosis, discharge and approximation

5.4 Safety

According to the study assessment, far infrared therapy was generally safe with no incidence of adverse events and well-tolerated by patients during the treatment of AV fistula and wound healing. Overall, studies reported that far infrared therapy was not associated with skin burn, infection, wound problem, hypersensitivity reaction and body temperature elevation during the sessions or the follow up.[23,25] Although the science and clinical research supporting this pill-free treatment have been validated by multiple trials yielding positive outcomes, the USFDA only has approved far infrared therapy as a treatment for muscle and joint pain/ stiffness.[27] This indicates that it is still considered an experimental or investigative treatment at this time.

5.5 Economic Implication

There was no retrievable evidence on the cost-effectiveness or other economic analysis related to far infrared therapy for AV fistulas and wound healing. However, the global market presented the price of the far infrared device starts from RM50.00 in Malaysia to R6,595.00 (RM1,636.31) in the global market, which are equipped with additional accessories at different degrees. The fee for far infrared sauna in Malaysia is charged to RM153.00 per session.[28,29]

5.6 Organisational Issue

International Commission on Non-ionising Radiation Protection (ICNRP) had updated a statement regarding far infrared radiation exposure. The previous statement did not include far infrared radiation due to small fraction impact of the total radiant heat energy. The guideline suggested, with regard to potential adverse delayed effects as revealed by experimental research, individuals should be discouraged from heating of the skin either simultaneously with or within 24 hours after exposure from artificial sources. Moreover, individuals who may be at risk from hyperthermia, such as individuals suffering from cardiovascular disease, should seek medical advice before using far infrared warming cabins (sauna). The statement also warned to not repeat the therapy in cases where chronic erythema (a skin reddening that lasts more than a day) and netlike colour changes occur. Instead, medical counsel should be sought to prevent the development of erythema *ab igne*. In addition, individuals with compromised heat pain sensation should not use infrared warming cabins, which include individuals under the influence of alcohol and tranquilizers.[30]

In June 2019, the ERA-EDTA had published the most recent version of the AV fistula and graft clinical practice guideline; pre- and post-operative care of arteriovenous fistulas and grafts for haemodialysis in adults. According to the guidelines, far infrared therapy is recommended for AV fistula maturation and long-term maintenance of AV fistula patency.[31]

5.7 Limitation

The limitations in the review were acknowledged and considered when interpreting the results. The selection of the studies and appraisal was done by one reviewer. The report contains only full-text English papers published in peer-reviewed journals, despite the fact that there was no language constraint throughout the search. This may have resulted in the exclusion of some pertinent articles and further reduced the number of studies. Since the majority of the studies had small sample sizes and only lasted for about a year, it was not possible to make any findings that would hold true over a longer time frame. A greater degree of heterogeneity was also noted across the studies, primarily due to the lack of standardisation in the far infrared therapy treatment protocol for AV fistulas and wound healing. Moreover, there is currently no single, accepted standard for energy setting, treatment interval, patient age, treatment of combined diseases, duration of diseases, etc. Consequently, patients with wound healing and those with AV fistulas should have their overall health assessed during the course of therapeutic treatment.

6.0 CONCLUSION

There was limited evidence of far infrared therapy for patients with AV fistula and its usage for wound healing. The evidence showed fair improvement in AV fistulas functions, wound healing rate and pain, and the effect might last up to six to 12 months. Up to three months after surgery, adjuvant daily therapy and rehabilitation exercises reduced post-surgical wound pain. In terms of safety, the evidence demonstrated that the technology is a safe and well-tolerated treatment. In contrast, although it has been recommended for AV fistulas maturation and long-term maintenance of AV fistulas patency, it is still being investigated and has not yet received USFDA approval as a therapy option.

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8.0 APPENDICES

8.1 Appendix 1: Literature search strategy

OVID MEDLINE® ALL <1946 to March 01, 2024>

1 SURGICAL FLAPS/ 60010
2 (surgical adj1 flap*).tw. 605
3 (island adj1 flap*).tw. 3097
4 (pedicled adj1 flap*).tw. 2101
5 WOUND HEALING/ 108054
6 (wound adj1 healing*).tw. 90785
7 ARTERIOVENOUS SHUNT, SURGICAL/ 11764
8 (arteriovenous shunt* adj2 surgical).tw. 10
9 (surgical arteriovenous adj2 shunt*).tw. 6
10 RENAL DIALYSIS/ 103864
11 (extracorporeal adj1 dialys*).tw. 219
12 hemodialys*.tw. 73646
13 (renal adj1 dialys*).tw. 1490
14 ARTERIOVENOUS FISTULA/ 15081
15 (arteriovenous adj1 aneurysm).tw. 602
16 (arteriovenous adj1 fistula*).tw. 19069
17 RENAL INSUFFICIENCY, CHRONIC/ 38217
18 (chronic kidney adj2 disease*).tw. 72850
19 (chronic kidney adj2 insufficienc*).tw. 259
20 (chronic renal adj2 disease*).tw. 4896
21 (chronic renal adj2 insufficiencies).tw. 5
22 INFRARED RAYS/ 14934
23 (heat adj1 wave*).tw. 2245
24 (infrared adj1 ray*).tw. 460
25 (infrared adj1 sauna).tw.15
26 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 441952
27 22 or 23 or 24 or 25 17385
28 26 and 27 284

OTHER DATABASES

PubMed
INAHTA
USFDA

} Sama MeSH and keywords as per MEDLINE search

8.2 Appendix 2: Hierarchy of evidence for effectiveness/ diagnostic

I Evidence obtained from at least one properly designed randomised controlled trial.

II-I Evidence obtained from well-designed controlled trials without randomization.

II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.

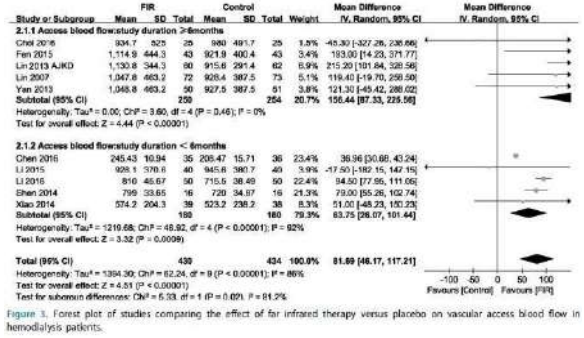
II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.

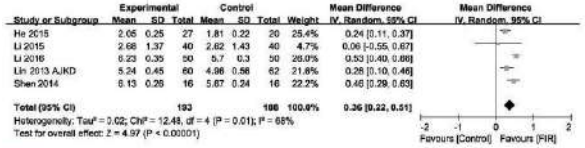
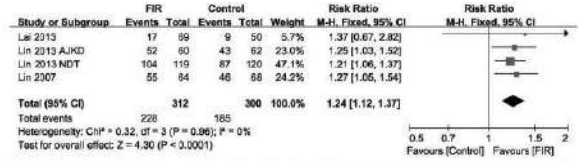
III Opinions or respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

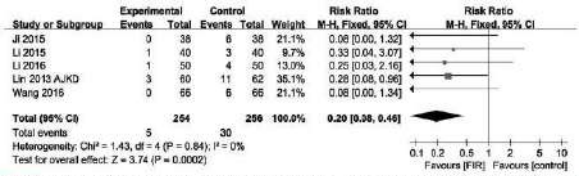
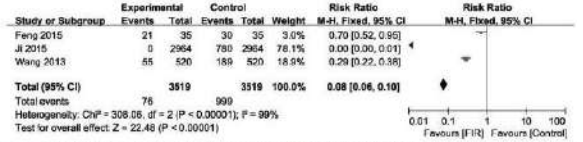
SOURCE: US/CANADIAN PREVENTIVE SERVICES TASK FORCE (Harris 2001)

8.3 Appendix 3: Evidence tables

Evidence Table : Efficacy
Question : What is the effectiveness of far infrared therapy for arteriovenous fistula and wound healing?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
1. Wan Q, Yang S, Li L et al. Effects of Far Infrared Therapy on Arteriovenous Fistulas in Hemodialysis Patients: a Meta-analysis. Renal Failure. 2017; 39(1): 613-622. China	**Systematic Review with Meta-analysis** **Objective:** To assess the effect of far infrared therapy on arteriovenous fistulas status in hemodialysis patients. **Method:** The researchers performed literature search on MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials (CCRCT), China National Knowledge Infrastructure (CNKI), the Chinese Biomedical Literature (CBM), Wang Fang, and VIP databases (all to April 2017) to identify eligible studies. Full-texts of the remaining 37 articles were retrieved for further review. At last, 21 eligibility trials were included in this meta-analysis. On the whole, randomisation was	I	37 studies 21 studies included in meta-analysis (1899 hemodialysis patients; 960 were treated with far infrared therapy, 939 were treated with placebo) Mean age of study participants ranged from 41.8 to 71.4 years	Far infrared therapy	Placebo	3 weeks to 12 months	**Effects of far infrared therapy on vascular access blood flow** Ten included studies that reported changes in vascular access blood flow was analysed under a random effects mode (n=864). The meta-analysis showed a significant increase in vascular access blood flow level in the far infrared therapy group compared with that of control group (MD, 81.69 mL/min; 95% CI, 46.17-117.21; p<0.001;), with significant heterogeneity between studies (p=0.00001; I^2=86%). In addition, the subgroup analysis showed that there was no difference effect on vascular access blood flow level among trials of different duration.  Figure 3. Forest plot of studies comparing the effect of far infrared therapy versus placebo on vascular access blood flow in hemodialysis patients. **Effects of far infrared therapy on arteriovenous**	

	incompletely described in the included trials, some randomised methods such as computer-generated randomisation random numbers were applied in nine studies for allocation. None of the included trials clearly described the allocation concealment ways that were used. None of the included studies clearly reported on blinding. None of the included studies reported on adverse events. **Limitations:** First, the included studies were small scale, and some trials included in this meta-analysis were of poor quality. Second, some trials were published in Chinese, which might induce publication bias. Third, most of the included studies just reported short-term (less than one year) outcomes of far infrared therapy, the long-term efficacy of far infrared treatment need to be proven by further long-term studies, and whether some factors (e.g., gender, age, race) affects the far infrared therapy curative effect has not been investigated in the included trials. Finally,						**fistulas diameter** The effect of far infrared therapy on arteriovenous fistulas diameter was assessed in five trials (n=381). Based on the results of pooled-analysis, the far infrared therapy has a significant increase in arteriovenous fistulas diameter level compared with that of the control group (MD, 0.36 mm; 95% CI, 0.22–0.51; p<.001), there was evidence of heterogeneity (p=0.01; I^2=68%).  Figure 4. Forest plot of studies comparing the effect of far infrared therapy versus placebo on arteriovenous fistula diameter in hemodialysis patients. **Effects of far infrared therapy on primary arteriovenous fistulas patency** The meta analysis assessed the effects of far infrared therapy on primary arteriovenous fistulas patency at 12 months in four studies. The pooled analysis results showed significant difference between two groups, with those who received far infrared therapy showing better primary patency rates compared with control (pooled risk ratio=1.24; 95% CI, 1.12–1.37, p<0.001), there was no evidence of statistical heterogeneity (p=0.96; I^2=0% shown.  Figure 5. Forest plot of studies comparing the effect of far infrared therapy versus placebo on primary arteriovenous fistula patency in dialysis patients. **Effects of far infrared therapy on arteriovenous fistulas occlusion** Five trials comprising 510 participants showed results for arteriovenous fistulas occlusion rates. Overall, therapy with far infrared radiation decreased arteriovenous fistulas occlusion rates (pooled risk	

	there was evidence of heterogeneities in these included studies. The researchers tried to control some of these differences by performing subgroup analysis and using random-effect models; however, it might influence the accuracy of this pooled analysis. **Heterogeneity:** Funnel plots for some key outcomes such as vascular access blood flow arteriovenous fistulas diameter were asymmetric which suggested there was publication bias among these studies.						ratio=0.20; 95% CI, 0.08–0.46) compared with that of control group (p<0.001). There was no evidence of heterogeneity in these trials (I^2=0%, p=0.84). It is indicated that therapy with far infrared ray has an advantage in reducing arteriovenous fistulas occlusion.  Figure 6. Forest plot of studies comparing the effect of far infrared therapy versus placebo on arteriovenous fistula occlusion in hemodialysis patients. **Effects of far infrared therapy on needling pain** Needling pain severity in patients was measured with a numeric rating scale. There are three trials reporting needling pain rates in hemodialysis. The pooled analysis result showed that the needling pain did decrease significantly in the groups receiving far infrared ray radiation therapy as compared with the control group not receiving far infrared ray (pooled risk ratio=0.08; 95% CI, 0.06–0.10, p<0.001). There was evidence of heterogeneity (p<0.00001; I^2=99%). In addition, another study not included in this pooled analysis also demonstrated that far infrared therapy improved the needling pain scores from four to 2 after 12 months.  Figure 7. Forest plot of studies comparing the effect of far infrared therapy versus placebo on needling pain in hemodialysis patients.	

Evidence Table : Efficacy
Question : What is the effectiveness and safety of far infrared therapy for arteriovenous fistula and wound healing?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
2. Hadimeri U, Warme A and Stegmayr B. A Single Treatment, Using Far Infrared Light Improves Blood Flow Conditions in Arteriovenous Fistula. Clinical Hemorheology and Microcirculation. 2017; 66: 211-217. Sweden	**Prospective Cohort Study** **Objective:** To investigate whether a single far infrared treatment could alter blood velocity, arteriovenous fistula diameter or inflammatory markers. **Method:** The arteriovenous fistula was examined with ultrasound before and after one single 40-minutes treatment with far infrared. The ultrasound measurements were performed with the patient in a supine position and the area of the arteriovenous fistula was investigated with ultrasound from the wrist up to the veins at the distal part of the upper arm. Three measure points were localised and marked: the first over the feeding artery, the second over the fistula area, and	II-2	n=30 Patients consisted of regular haemodialysis, treated with peritoneal dialysis and not yet on regular dialysis.	Far infrared therapy	NI	NI	**Effectiveness:** • One session of far infrared exposure for 40 minutes resulted in a significant increase in blood velocity over the fistula from a mean of 2.1 m/s (±1.0) to 2.3 m/s (±1.0, p=0.02). • There was no significant increase in arterial (1.71 m/s to 1.78 m/s) or venous blood velocity (0.87 m/s to 0.93 m/s, p=0.056). • The venous diameter increased significantly from 0.72 cm (±0.2) to 0.80 cm (±0.2, p=0.006). • There was no significant change in diameter of the artery or fistula. • The change in blood velocity or diameter of the arterial, fistula or venous part of the arteriovenous fistula did not differ between patients with or without diabetes mellitus, those who were or were not receiving haemodialysis, statins or anticoagulants or between men and women. • After far infrared, the heart rate decreased (mean 72±9.8 beats/min to 68±9.4, p=0.043) and LDL cholesterol was reduced (mean 2.33 mmol/L±1.2 versus 2.28 mmol/L±1.10, p=0.091) while there was no change in systolic or diastolic blood pressure, mean arterial pressure, serum-orosomucoid or serum-urate. • The increase in fistula blood velocity after far infrared correlated positively with base line serum-urate (r_o = 0.52, p=0.004) and the increase in venous diameter correlated with the base line orosomucoid levels (ro = 0.51, p = 0.005). There was no correlation between arteriovenous fistula blood velocity change after far infrared to age,	

	the third point over the arterialised vein (distal part of the arteriovenous fistula localised towards the heart; here denominated vein). After the ultrasound investigation, treatment with far infrared was performed for 40 minutes over the area comprising the three marked points, at a distance of 25 cm above the skin surface. Directly after far treatment, new blood sampling was performed and blood pressure was measured.						blood hemoglobin, dose of ESA, baseline systolic or diastolic BP, MAP or LDL- cholesterol. **Safety:** There was no side effect experienced by far infrared. Some patients, but not all, noticed a sensation of 'warming up of the area' during the treatment. This sensation lasted for a limited time and disappeared before the second ultrasound examination was performed.	

33

Evidence Table : Efficacy
Question : What is the effectiveness and safety of far infrared therapy for arteriovenous fistula and wound healing?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
3. Park JH, Yoon JY, Jeong MG et al. Far-infrared Radiation to Improve Clinical Outcomes After Arthroscopic Rotator Cuff Repair: a Prospective Randomised Comparative Clinical Study. Clinics of Orthopedic Surgery. 2023; 15(5): 826-833. Korea	**Randomised Controlled Trial** **Objective:** To evaluate the effects of postoperatively applied far infrared with regard to early pain, range of motion and tendon-to-bone healing after arthroscopic rotator cuff repair. **Method:** Consecutive patients who underwent arthroscopic rotator cuff repair between November 2019 and June 2020 were enrolled. In the far infrared group, the far infrared using a radiator device was applied for 30 minutes per session twice daily from the first postoperative day. This application lasted for 10 weeks during the postoperative period. No far inrared was applied to the control group. Other rehabilitation programs were done in the same manner as those of the far infrared group. The	I	n=64 Far infrared group=31 Control group=33 Mean age was 59.7 ± 9.4 years (range, 38-76 years) Inclusion criteria: -preoperative magnetic resonance imaging (MRI) diagnosis of a small- to medium-sized (< 3 cm) tear involving supraspinatus and infraspinatus tendons and evaluation of anatomical healing at six months using an MRI.	Far infrared therapy + rehab program	Rehab program	5 weeks, 3 and 6 months	**Pain intensity** • The VAS at five weeks postoperatively, the primary outcome of this study, was 1.7 ± 1.0 in the far infrared group, which was statistically significantly lower than that in the control group (2.8 ± 1.4, p=0.002). • At postoperative three months, corresponding to the endpoint of radiation, the far infrared group also showed significantly lower VAS (2.4 ± 1.3 vs. 3.2 ± 1.8, p=0.041) than the control group. • At six months postoperatively, there were no significant differences in functional scores including VAS between the two groups. **Range of motion** There were no significant differences between the two groups at three months after surgery or at the final follow-up. **Wound healing** Regarding anatomical healing, which was assessed using MRI at six months postoperatively, one (3.2%) healing failure occurred only in the far infrared group, showing no significant difference between the two groups. **Safety** Potential adverse effects of far infrared such as skin burn, rash, infection, wound problem, hypersensitivity reaction and body temperature elevation did not occur in any patients.	

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	radiator device was located at a distance of 30 to 35 cm from the patient's skin. Patients themselves marked on a checklist whether far infrared was applied to them. **Limitations:** -This study has a relatively short-term (six months) follow-up because the authors investigated the efficacy of postoperatively applied far infrared related to the early pain relief, range of motion, and healing rate after arthroscopic rotator cuff repair following the previous pilot study. - Athough authors expected better clinical outcomes in the far infrared group because of the longer period of far infrared application than the previous pilot study, there was a significant difference in only early pain relief between the two groups, but not in range of motion, functional score, or							

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	healing rate.							

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4. Mu Y, Jin Z, Yan Y et al. The Possibility of Using Far Infrared Fabrics to Promote Wound Healing from the Cellular Level. Fibers and Polymers. 2020. China	**Experimental Study** **Objective:** To explore the effects of different far infrared fabrics on two kinds of wound healing epithelial cells, HaCaT and Huvec. **Method:** Four kinds of far infrared nanoparticles of tea carbon fiber, bamboo charcoal fiber, coffee carbon fiber, graphene fiber, were added into the polymer polymerisation process by blending spinning method, four kinds of far infrared polyamide fibers with high		Keratinocytes HaCaT and venous endothelial cells Huvec	Far infrared	No treatment	NI	**Range and Difference of Far Infrared Emissivity of Fabrics** • The results showed that there was significant difference between CCF and TCF ($p<0.05$). There was more significant difference between GF and TCF ($p<0.03$). The difference between other groups was not statistically significant ($p\geq0.05$). Therefore, it can be concluded that tea carbon fabric has the highest far infrared emissivity and the best performance among the four kinds of far infrared fabrics. • Due to the difference of size and shape, the nanoparticles of different materials have different properties, the ability to absorb and emit light energy is different. Therefore, the four kinds of far-infrared fabrics have different far-infrared emissivity due to the different materials of nanoparticles. **Relationship between Fabrics Far Infrared Emissivity and Skin Blood Perfusion Promotes**	

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	emissivity were spun. The four far infrared fibers are spun into four pieces of far infrared fabrics of the same specification by using seamless knitting machine. Two types of cells associated with superficial wound healing, keratinocytes HaCaT and venous endothelial cells Huvec, were selected for cell experiments. Cell proliferation experiment was conducted to examine the effect of far infrared radiation on the proliferation ability of these two cells. Cellular wound healing experiments were performed to examine the effect of far infrared fabrics on cell migration. The four kinds of fabrics were applied to the plastic cell culture plates, and the cells were cultured for 0 to 12 days with different lengths of continuous far infrared radiation. In the cell proliferation experiment, the NC (normal controls) group						**Multiple** • The far infrared emissivity of the four kinds of fabrics was compared with the promotion of the corresponding fabrics on the skin blood flow perfusion of the subjects, and the scatter diagram was made and the curve was fitted. The SPSS was used to test the Person correlation, when r>0.8, the relationship between the far infrared emissivity of the fabrics and the promotion of skin blood perfusion was verified. • The Person correlation coefficient of the two was r=0.81>0.8, and the fitting curve was in line with the linear increasing function y=10.38x−9.003 (y: the promotion amount of different fabrics on the skin blood perfusion, x: the far infrared emissivity of the fabrics). Therefore, in a certain range, the higher the far infrared emissivity, the more significant the promotion of skin blood perfusion. **Analysis of Far Infrared Radiation Effect on the Proliferation of Cells** • The proliferation curve showed that the proliferation ability of HaCaT and Huvec in FIR group was higher than that in NC group. It can be seen that compared with NC group, the proliferation ability of keratinocytes HaCaT in TCF group was stronger than that in NC group (p=0.011), BCF (p=0.013) and CCF (p=0.030) groups were second only to TCF. • Cell proliferation ability of GF group was lower than that of other 3 far infrared fabrics, but also significantly higher than NC group (p=0.033). There was also significant difference between TCF group with the best effect and GF group with the worst effect (P=0.049).	

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	(without any far infrared radiation) was set as the experimental control group.						• When Huvec was compared with NC group, the proliferation ability of TCF group and CCF group was similar and the strongest (p=0.014, p=0.016). The proliferation ability of BCF and GF group was lower than that of other groups, and the difference with NC group was still statistically significant (p=0.023, p=0.031). • Therefore, it can be concluded that the far infrared radiation of the fabrics can promote the proliferation of HaCaT and Huvec epidermal healing related cells, and among the two cells, tea carbon fabric has the best effect. **Effect of Far Infrared Emissivity on Cell Proliferation** In the keratinocytes HaCaT, the Person correlation coefficient r=0.95>0.8, suggesting that the two are correlated, and the fitting curve conforms to the linear function y=3.78x−3.26. In the venous endothelial cells Huvec, the Person correlation coefficient between the tow is r=0.82>0.8, and the fitting curve conforms to a linear function y=8.98x−7.83. Therefore, within a certain range of far infrared emissivity, the higher the far infrared emissivity of the fabrics, the more significant the promotion of HaCaT and Huvec proliferation. **Effect of Fabrics Far Infrared Radiation on Cell Migration** Within 24 h, the keratinocytes HaCaT in the far infrared group crawled further than that in the NC group. Among these fabrics, the TCF and CCF groups had the best effects, which were significantly different and	

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							statistically significant compared with the NC group. In Huvec, the healing area in the far infrared group was also significantly larger than that in the NC group, and the TCF group was significantly different from the NC group ($P<0.05$). By comparing the differences between the TCF-ST group, far infrared group and NC group in HaCaT and Huvec, it can be seen that the healing area of TCF-ST group in 24 h was slightly larger than that of NC group, but smaller than that of other four far infrared groups. Therefore, it can be concluded that the far infrared radiation of fabrics can promote the migration ability of HaCaT and Huvec. And in a certain time range, the promotion of epithelial cell migration ability is proportional to the radiation duration of far infrared fabrics.	

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5. Dewi VNL and Ayuningtyas IF. Infrared is More Effective in Perineum Wound Healing During Postpartum Than Iodine.	**Non-randomised Experimental Study** **Objective:** To study the effect of far infrared on perineum wound healing. **Method:** The sampling technique	II-I	N=30 (aged 20-30 years old) Far infrared group: 15 Iodine group: 15	Far infrared therapy	Iodine	1, 2 and 3 days	• In both study groups experienced an increase in the mean or average percentage of day-to-day effectiveness of therapy. The control group increased from 50.44% to 77.78% and 30.78% of the intervention group to 73.11%. This means that in both these therapies are effective in postpartum maternal perineum wound healing. • The result showed a significant difference (p=0.00) in the control group only at day 1 to day 2 with a mean of 15. In the intervention group	

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Int J Res Med Sci. 2015; 3(1): 6-9. Indonesia	was purposive sampling. Samples were puerperal women who suffered lacerations in perineum at *Rumah Bersalin* Amanda. Samples were of 30 people that divided into two groups. The study inclusion: Postpartum 0-1 week, mothers with uncomplicated spontaneous parturition morbidities (diabetes, anaemia, hypertension), and spontaneous or episiotomy perineum rupture grade II. Exclusion: Mother with childbirth complication, moved her residence during the study period, and perineum rupture grade III and IV. REEDA Scale was used to assess healing of the perineum. It comprised of five items related to redness, oedema, ecchymosed, discards, and approximation. The maximum score for REEDA was 15 and the minimum score was zero. First 15 postnatal mothers allocated to group 1						seen significant difference on day 1 to day 2 (p=0.00) and on day 2 to day 3 (p=0.04). • Results mean greater in the intervention group than in the control group is 31.7, it showed the infrared more effective in postpartum maternal perineum wound healing.	

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	received infrared light to the perineum sutured for 10 minutes with a distance of 45 cm. Next 15 postnatal mothers allocated to group 2 received iodine once a day. Each therapy was provided once daily for seven consecutive days. Healing of wound was observed after giving the treatment using REEDA Scale.							

TECHNOLOGY REVIEW (MINI - HTA)

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