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The Use of ErCrYSGG Versus Diode Laser in Gingival Melanin De-pigmentation (Clinical study)

(Gingival Melanin Depigmentation)

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ABSTACT

AIMS: is to compare the effectiveness of Er Cr YSGG & Diode laser on de pigmentation of gingival melanin pigmentation & to compare their possible complication.

MATERIALS AND METHODS: ten patients were collected from Dentistry college, Oral & Maxillofacial Department at Mosul University complained from esthetic problem related to gingival melanin hyper pigmentation.Both upper & lower jaws were divided into two quadrants right& left.each quadrant is consider as one unit in this study, each quadrant of upper & lower jaws were treated by ErCr YSGG & Diode laser respectively. The pigment score (0=no pigment,1= light brown,2= dark brown,3= black)Gupta &Dummet1966[(39)], Visual analogue Scale (VAS) 0-10(0 no pain, 10 the maximum pain intensity),bleeding score(0= no bleeding, 1= slight bleeding, 2= moderate bleeding, 3= severe bleeding) Lagdive etal2009[(40)] ,discomfort, other complication, healing score (0=complete epithelization,1= incomplete epithelization ,2= ulcer,3=tissue defect or necrosis) Lagdive et al 2009[(40)] these variables were assessed immediately , one, two, three, four & five weeks after laser therapy.

RESULTS: The age of the patients were ranged from16-43 years with mean age 24.4 years, regarding sex distribution nine males with one female were included in this study. there was highly significant difference in pigment score before & after treatment by laser therapy $p \leq 0.001$. There were highly significant difference among variables immediately , one ,two, three, four & five weeks after waterlase application $p \leq 0.001$,except for VAS there was no significant difference $p \geq 0.001$. there were highly significant difference among different variable means after diode laser therapy $p \leq 0.001$, except for VAS $P \geq 0.001$. there were highly significant difference in VAS $P \leq 0.001$between two lasers ,while non significant difference among other variable means $p \geq 0.001$. highly significant differences were found in VAS & healing score $p \leq 0.001$ & non significant differences among the other variable means $p \geq 0.001$one week after treatment. there were nonsignificant differences among all variables $p \geq 0.001$ two weeks following laser application.

CONCLUSION: The most common cause of pigment was smoking were frequently distributed among male ,the laser depigmentation is an effective, safe, simple & accepted by the patients .,both waterlase & diode laser are effective in oral melanin depigmentation,the use of diode laser is associated with pain &delayed healing compared with waterlase. according to result of this study we found that waterlase is better than diode laser in melanin depigmentation.

Key Words: melanin ,smoking, waterlase,diode laser.

INTRODUCTION

Oral melanin pigmentation has been observed in all racesand is usually limited to the keratinized mucosa. It could be an aesthetic issue for some patients, especially when it is located in the anterior labial gingival combined with a high smile line and is not uniform in appearance[(1)] Melanin is a pigment produced by melanocytes that reside in the basal layer (stratum basale)of the epidermis. It is stored in vesicles called melanosomes and is transferred to adjacent epithelial cells via dendritic processes. Melanin protects DNA from the ionizing, damaging effect of UV radiation. It absorbs the UV radiation and transforms it to heat through a process described as "ultrafast internal conversion[(2,3)]. Melanin, ubiquitously expressed in most organisms, is a polymer composed of polyacetylene, polypyrrole and polyalanine. It is a derivative of tyrosine and is comprised of different proportions of smaller component molecules that give rise to three types of melanin: eumelanin, pheomelanin and neuromelanin[(4-7)]. Eumelanin comprises of numerous cross-linked 5,6-dihydroxyindole (DHI) and 5,6-dihydroxyindole-2-carboxylic acid (DHICA) polymers[(8)].Eumelanin is the most abundant form in humans. It is the main determinant for the skin and hair coloration. The two types of eumelanin, black

and brown, are responsible for colors black, grey, brown and yellow. Small amounts of black eumelanin in the absence of other pigments result in grey (hair), while small amounts of brown eumelanin in the absence of other pigments result in blond. Brown eumelanin is usually present in young Europeans while older Europeans and non-Europeans express mostly black eumelanin. Pheomelanin is also found in the skin and hair and attributes a reddish hue. Its polymeric structure contains benzothiazine and requires L-cysteine instead of DHI and DHICA in eumelanin[10].Neuromelanin is a dark pigment found in the dopamine and noradrenergic neurons in the substantia nigra pars compacta and locus coeruleus of the human brain, increasing with age and reaching its peak around the age of 20 years[8].While its function remains unknown, its absence is associated with Parkinson's disease[9,11].

Melanin is responsible for normal physiologic pigmentation within the oral cavity. When present, it is found most commonly on the gingiva, hard palate, mucosa or tongue[11]. Its appearance may be diffuse, solid or irregularlyshaped (mottled or macular), with different shades of color ranging from light brown to black. The great majority of oral melanin pigmentation is physiologic. Occasionally hyperplastic or neoplastic lesions may develop. Hyperplastic benign lesions include ephelides (freckles), lentigo and melanotic macules[12]. Neoplastic lesions include nevi (moles) and melanomas that may develop anywhere in the oral cavity. Nevi are benign and malignant transformation is highly improbable[12].Oral melanomas represent a malignancy, have a poor prognosis and are associated with a high mortality rate[12].In addition, oral melanin hyperpigmentation has been associated with habitual tobacco smoking[13-19] .The development of melanin pigmentation caused by smoking is known as smoker's melanosis, and its prevalence is dose-dependent[13-16,19]. Smoker's melanosis is more prevalent in the labial gingiva of the anterior teeth,[15,16]and smoking cessation decreases the prevalence of pigmentation in relation to the number of years after cessation[20].Moreover, secondhand exposure to environmental tobacco smoke is associated with increased oral melanin pigmentation in the gingiva of children with parents who smokehighlighting the role of smoke in melanin production by gingivalmelanocytes[21].

Management of Melanin Pigmentationnon-surgical approaches as well as surgical intervention have been suggested for the management of melanin pigmentation. Non-surgical approaches have been proposed for the management of melanin pigmentation, both of the skin and in the oral cavity. The use of pharmacological agents (monobenzone, mequinol or hydroquinone) has been applied in cases where skin de-pigmentation is required, as in the treatment of vitiligo.[22,23]Hydroquinone is not used in the US in over-the-counter preparations, and the FDA has included the drug as potentially carcinogenic (US FDA 2006) [24] .The use of pharmacological agents has also been proposed for the elimination of gingival pigmentation but has demonstrated limited success. Hirschfeld and Hirschfeld[25]used either 90% phenol or 95% ethanol solutions to reduce oral pigmentation by inducing chemical burn and sloughing of the epithelium. However re-pigmentation and relapse occurred in all cases shortly after the application of either agent.

Alternative surgical approaches have been reported for the elimination of melanin gingival pigmentation, including free gingival grafts, gingivectomy, de-epithelialization by bur abrasion, scalpel, cryosurgery and laser . The potential of autogenous epithelialized gingival grafts has been established for the management of physiologic gingival pigmentation or amalgam tattoos.[26-31]. However, bone denudation carries the risk of protracted healing period, attachment loss and significant discomfort[31]. The pigmented epithelium was removed at a second stage after complete healing by gingivoplasty[32] De-epithelialization with a high-speed hand piece and a diamond bur (2 mm or 2.5 mm of diameter) has been proposed by Farnoosh[33]. The denudation of connective tissues from its overlying epithelium by scalpel to eliminate melanin pigmentation were studied. The technique requires "shaving" of the epithelial layer with a surgical blade under local anesthesia with epinephrine for control of the bleeding. The surgical wound was covered with a periodontal dressing. Residual pigmentation was observed two weeks post-operatively and was removed at a later visit. This technique should not be applied in patients with a thin gingival biotype as gingival fenestrations and bone exposure may occur.

Cryosurgery has also been proposed for the management of melanin gingival pigmentation. Tal et al.,[34]reported the use of a gas expansion cryoprobe cooled to -81ºC and applied to the pigmented gingiva for 10 seconds. Gingiva was thawed spontaneously within 1 minute, and necrosis became apparent within 1 week. Healing and keratinization was complete within 3-4 weeks and de-pigmentation was successful 20 months post-operatively. The use of liquid nitrogen has also been tested in patients with melanin pigmented gingiva[35]. The liquid nitrogen (-196Cº) was applied directly to the gingiva with a cotton swab in one or two visits. No relapse was reported in 20 patients followed for 3-24 months. Cryosurgery requires the use of additional materials, and depth control is difficult. The risk of increased tissue destruction needs to be considered. The gaseous fluorocarbon 1,1,1,2 tetrafluoroethane (TFE), used in the field of endodontics for cold pulp testing, is readily available and has also been tested for gingival melanin de-pigmentation.TFE was applied with a cotton swab on areas with gingival pigmentation in 21 patients. They reported a relapse of pigmentation 30 months post-operatively in two patients that were smokers[36]. The use of LASERs has also been proposed for the management of oral melanin pigmentation. The CO2,[37,38] Er,Cr:YSGGand Nd:YAG[39-41] LASERs have been used. The Nd:YAG LASER with an invisible, near-infra-red light (wavelength of 1,064 nm) has a high affinity for dark pigments, making it particularly suited for de-pigmentation. However, ablation should be

performed with caution in areas of thin tissue and prominent roots, as gingival fenestration and bone exposure may occur.The advantages of this technique include minimum damage to theunderlying tissues when used cautiously, speed of the procedure and minimal bleeding. However, more time is required for the healing of the periodontal tissues.

AIMS OF STUDY is to compare the effectiveness of Er Cr YSGG & Diode laser on de pigmentation of gingival melanin pigmentation & to compare their possible complication.

MATERIALS AND METHODS

Materials:

1- patient sample : ten patients were collected from Dentistry college, Oral& Maxillofacial Department at Mosul University complained from esthetic problem related to gingival melanin hyper pigmentation, their age ranged from 16 to 43 years with mean age 24.4 year female to male 1 to 9 all patients selected were with no systemic diseases.
2- ErCrYSGG laser , 2780nm(waterlase,Iplus USA 2011).
3- Diode laser 810nm (Elexxion,Germany 2010).
4- Local anesthesia (Lidocain 2% with Epinephrine 1:180000) Antiqia – Colombia .
5- Dental needle 27 G Dentject Korea.
6- Spray anesthesia, 10% liodcain
7- Disposable diagnostic set, mirror, explorer.
8- Disposable gloves.
9- Gauze 1×1 inch ,china.
10- Digital camera.Dimage A 200,Japan.
11-Googles.

Methods :

Aspecial case sheet Figure (1) was used to record the information from the patient include age, sex .causes like racial, smoking .duration & the number of packet per day ,drugs like antimalaerial,contraceptive, doxycyclin ,then the oral cavity was examined by mirror& probe under dental light, all patients selected have melanin pigmentation in labial & buccal surfaces of the gingiva in upper & lower jaws , melanin pigment score was used inthis study according to Dummett and Gupta, 1966)[39] . This melanin pigmentation index manifested on clinicalexamination of gingival tissues. The criteria is asfollows:

0 = Pink tissue (no clinical pigmentation).
1 = Mild, light brown tissue (mild clinical pigmentation).
2 = Medium brown or mixed pink or brown tissue(moderate clinical pigmentation).
3 = Deep brown or blue/black tissue (heavy clinicalpigmentation).

The gingival covering each tooth was assessed in score system & the total scores were divided by the number of teeth to gain the mean score for each patient which ranged from 0 to 3,the same score was used to evaluate the pigmentation ,immediately,one, two,three,four,&five weeks after laser therapy.Both upper&lower jaws were divided into two quadrants right,left. eachquadrant is consider as one unit in this study, each quadrant of upper &lower jaws were treated by ErCrYSGG & Diode laser respectively at the same time to allow compares.,& after one week the other quadrants were treated in the same manner. The Visual analogue Scale (VAS) 0-10(0 no pain, 10 the maximum pain intensity),bleeding score(0= no bleeding, 1= slight bleeding, 2= moderate bleeding, 3= severe bleeding)Lagdive etal2009[40],discomfort,other complication,healing score (0=complete epithelization,1= incomplete epithelization ,2= ulcer.3=tissue defect or necrosis) Lagdive etal2009[40] these variables were used immediately & one,two,three,four&five weeks after laser therapy. An ErCr YSGG laser device (waterlase ,biolase Iplus, USA 2011) Figure(2) emits photons at a wavelength of 2790nm, laser pulse duration 140 -150 microsecond,frequency of 20 Hz & and power output ranging from 0-6 Watt (pulse energy 0-300mj) was employed .These laser is delivered through zirconium,fluoride trunk fiber connected to goldhand piece with a fiber tip,MC3,600micrmeters, power setting from 2-2.5 watt, air setting at 11%& water setting of 30% in noncontact mode 1-1.5 mm away from tissue was used with angle of 135-150 degrees between tip shank & lasing tissue surface.
Asemiconductor diode laser unit Elexxion Germany 2010 Figure (3) ,810 nm,was used for depigmentation for mandibular gingiva ,laser ablation was applied from mucogingival junction toward free gingival including papilla,removal of the ablated tissue were removed using sterile gauze ,a smaller size laser tip 400 micrometer was used at gingival margin to achieve better control, the diode parameters used in this study, pulse output 50 watt,frequency12000 Hz ,pulse duration 15 microseconds & mean output 6watt, the tip is adapted to Claro ergo headpiece. Photo was taken before treatment ,immediate, one, two.three,four & five weeks after treatment. Local or spray anesthesia were not used only if patients not withstand treatment.

Statistical analysis:

Data was processed in computer with use of standered program (SPSS 11.5 for windows) ,the statistical calculation of differences was done with the chi square & Friedman tests The following symbols were used for different levels of significance in tables . NS not significant,p≥0.005. significant p≤ 0.005. highly significant p≤0.001.

RESULTS

Table(1) shows the age range of the patients were from16-43 years with mean age 24.4 years, regarding sex distribution nine males with one female were included in this study. Only two patients presented with racial pigmentation while the other melanin pigmentation were due to smoking ,all smokers were consumed 1 packet daily,only two patients were consumed 1.5 packets daily,concerning the duration of smoking it range from 3 to 20 years, allpatients selected with pigment score 3 . Table(2) reveals the mean pigment score before treatment which was 3& immediately after treatment with both ErCr YSGG& Diode lasers, the pigment score mean were 0.5 & 0 respectively after watrelase & Diode laser therapy,there is highly significant difference in pigment score before & after treatment by laser therapy p≤0.001. Table(3) Demonstrate different variable means,immediately,one,two,three,four& five weeks after waterlase therapy .It shows that pigment score ranged from 0.5 immediately after therapy to 0 three weeks later,VAS mean ranged from 0.2 to 0 five weeks later,bleeding score ranged from 1.15 immediately to 0, discomfort ranged from 0.2 immediately after waterlase to 0 five weeks later&healing score ranged from 2 to 0 after five weeks.There were highly significant difference among variables immediately &one ,two, three, four &five weeks after waterlase application p≤0.001,except for VAS there was no significant difference p≥0.001.

Table(4) shows the different variable means immediately ,one,two,three,four&five weeks after Diode laser therapy.It reveals that pigment score mean ranged from 0 immediately after therapy to 0.1 after one week& 0 after second, third ,fouth & fifth weeks,VAS mean ranged from 4.6immediately to 1.6 after one week & 0 at second third,fourth & fifth week after treatment, Bleeding score mean was 1.1 immediately after therapy & 0 one ,two,three,four&five weeks after therapy, discomfort mean score was 0.6 immediately & 0 one ,two, three, four &five weeks after waterlase therapy & healing mean score was 2.1 mmediately,1.2 after one week & 0 after two,three,four &five weeks after laser therapy,there were highly significant difference among different variable means after diode laser therapy p≤0.001. except for VAS there was non significant difference P ≥ 0.001. Table(5) reveals the difference of variable means immediately after waterlase &diode lasers therapy ,it shows highly significant difference in VAS P≤0.001 ,while non significant difference among other means variable p≥0.001. Table(6) shows difference in variables mean one week after waterlase &diode laser therapy.it reveals highly significant differences in VAS &healing score p≤0.001 &non significant differences among the other variables p≥0.001. Table(7) demonstrate the difference in variables mean two weeks after waterlase &diode lasers treatment ,there were nonsignificant differences among all variables p≥0.001.

DISCUSSION

Oral pigmentation is adiscoloration of oral mucosa & gingival associated with several endogenous& exogenous factors. Oral pigmented lesion have various etiological factorsincluding drugs,heavy metals, genetics ,endocrine disturbances & inflammation[41-43].Also smoking may stimulate melaninproduction& cause melanin pigmentation[43-45],the intensity of pigmentation is related to duration of smoking & number of cigarettes consumed, this type of oral pigmentation is mostly located in the anterior labial gingival[41-45]& the mechanism by which smoking induced pigmentation remain unknown[7]. In this study nine males to one female were presented & this distribution disagree with other studies[41-45]& this result may be due to smoking habit is not frequently accepted among females in our society due to social& other factors. The most common cause of melanin pigmentation was smoking (8patients) followed by racial pigmentation(two patients), the average packet consumed per day was 1.125,& the average duration of smoking was 5.8 years& this result is consistent with other study[46] which claimed that the intensity of pigmentation is related to duration & numbers of cigarette consumed.

Gingival melanin pigmentation causeesthetic concern & cosmetic therapy is becoming important for patients suffering from this problem.recently various laser technique were introduced & erbium laser has proven its effectiveness in depigmentation by ablation of pigmented gingival[47-49]. Laser device are used in various field in dentistry among them ErCr YSGG 2780 nm is applied in treatment of both hard & soft tissue,because of high energy absorption by water ,less tissue degeneration with very thin surface interaction occur after ErCr YSGG laser irradiation it becomes preferable to other types of lasers ,because of these characteristics ,use of ErCr YSGG laser can minimize the damage to deep tissue & prevent scarring from laser application, it also favorable for wound healing& has bactericidal effect[50]& provide photo stimulation(low level laser therapy).[51,52]
The semiconductor diode laser is emitted in continuouswave, or gated pulse modes,and is usually operated in contact method using flexible fiber optic delivery system.Laser light at 800-980 nm is poorly absorb by water,but highly absorb by hemoglobin& other pigments[53]. Since the diode basically dose not interact with dental hard tissue, this laser is

anexcellent soft tissue surgical laser indicated for cutting&coagulation of gingival &oral mucosa &for soft tissue curettage or sulucular debridement,the diode laser exhibit thermal effects using the hot-tip effect caused by heat accumulation at the end of fiber & produce relatively thick coagulation layer on the treated surface, their usage is quite similar to electrocauterization, the advantage of diode lasers are the smaller size of the units as well as the financial cost.Diode laser does not produce any deleterious effects on the root surfaces,thus it is generally considered that diode laser surgery can be performed safely in close proximity to dental hard tissue[40].

In this study we found a highly significant difference in pigment score before & immediately ,one,two,three,four&five weeks after both waterlase &diode laser therapy &this result is consistent with other studies[40,47]& nonsignificant difference in pigmentation immediately ,one, two, three, four &five weeks after treatment by waterlase &diode laser & this explain that both lasers were effective in melanin depigmentation.Also there were no significant difference in bleeding&discomfort after treatment by the two lasers.While there was highly significant difference in VAS immediately after treatment by biolase &diode laser& this result can explained by thermal effects of diode laser that lead to heat accumulation at the end of fiber that produced relatively thick coagulation layer on treated surface which have asimilar action of electrocauteriztion[40]also by technique used as noncontact method by waterlase.There was highly significant difference in healing score one week after waterlase &diode laser therapy&this can explained by the fact that diode laser produce thermal effects which lead to rise in temperature[54], as atemperature increase at the surgical site,the soft tissue are subjected to warming(37-60 c^o),protein denaturation,coagulation(60c^o),welding (70-90c^o),vaporization(100-150c^o)& carbonization (200c^o)[55],the rapid raise in the intercellular temperature &pressure lead to cellular rupture ,necrosis& delayed healing[49].

CONCLUSION

The most common cause of pigment was smoking were frequently distributed among male ,the laser depigmentation is an effective,safe,simple& accepted by the patients .,both waterlase & diode laser are effective in oral melanin depigmentation,the use of diode laser is associated with pain &delayed healing compared with waterlase.according to the result of this study we found thatwaterlase is better than diode laser in melanin depigmentation.

SUGGESTION

1- Longterm study with follow-up for 6 monthsto 1 years to assess the re-pigmentation.
2- Acomparism of waterlase with other types of laser like CO2 & NE YAG lasers.

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Table (1): Sample distribution according to age,sex, cause of pigmentation & pigmentation score

Pigment score mean before treatment	Pigment score mean immediately after ErCrYSGG	Chi square test	Pigment score mean immediately after Diode	Chi square test
3	0.5	X2=20.000,df=1,p=0.000*	0.000	X2=20.000,df=1,p=0.000*

Table (2): Relation of pigment score mean before and immediately after laser therapy

			Causes of Pigmentation				
No.	Age	Sex	Racial	Smoking	No. of packet/day	Duration/year	Pigment score
1-	16	male	no	yes	1	3	3
2-	19	male	no	yes	1	4	3
3-	43	male	no	yes	1	20	3
4-	17	male	no	yes	1	2	3
5-	37	male	no	yes	1.5	1.5	3
6-	17	male	no	yes	1	2	3
7-	19	male	no	yes	1	4	3
8-	23	female	yes	no			3
9-	23	male	yes	no			3
10-	30	male	no	yes	1.5	10	3

Table (3) Relation of different variable means immediately ,one, two, three, four and five weeks after waterlase therapy

Variables	immediately	One week	Two weeks	Three weeks	Four weeks	Five weeks	Chi square test
Pigment score	0.5	0.4	0.2	0	0	0	84.4,df,5,p=0.000*
Visual analogue scale	0.2	0	0	0	0	0	15.0, df,5,p=0.10
Bleeding score	1.15	0	0	0	0	0	100.,df,5,p=0.000*
Discomfort	0.2	0	0	0	0	0	20.0 df,5,p=0.000*
Healing score	2	0	0	0	0	0	100. df,5,p=0.000*

Table (4) Relation of different variable means immediately ,one, two, three, four and five weeks after diode laser therapy

Variables	immediately	One week	Two weeks	Three weeks	Four weeks	Five weeks	Chi square test
Pigment score	0	0.1	0.2	0	0	0	99.35,df,5,p=0.000*
Visual analogue scale	4.6	1.6	0	0	0	0	85.70, df,5,p=0.10
Bleeding score	1.1	0	0	0	0	0	90.00.,df,5,p=0.000*
Discomfort	0.6	0	0	0	0	0	60.00, df,5,p=0.000*
Healing score	2.10	1.2	0	0	0	0	99.35, df,5,p=0.000*

Table (5) Relation of different variable means immediately after waterlase and diode lasers therapy

Variables	Waterlase	Diode	Chi square	Degree of freedom	Significance
Pigment score	0.5	0	7.000	1	0.080

Table (6) Relation of different variable means one week after waterlase and diode lasers therapy

Variables	Waterlase	Diode	Chi square	Degree of freedom	Significance
Pigment score	0.4	0.1	6.00	1	0.014
Visual analogue scale	0	1.6	16.00	1	0.001*
Bleeding score	0	0			
Discomfort	0	0			
Healing score	0	1.2	20.00	1	0.000*

Table (7)Relation of different variable means two weeks after waterlase and diode lasers therapy

Variables	Waterlase	Diode	Chi square	Degree of freedom	Significance
Pigment score	0.2	0	20.00	1	0.157
Visual analogue scale	0	0			
Bleeding score	0	0			
Discomfort	0	0			
Healing score	0	0			

Laser depigmentation case sheet

Name: Age: Sex:
Chief complaint:
Smoking: number of packet: duration:
Racial:
Hormonal:
Drugs: name: dose: duration:
Before treatment:
Pigment score: 0 1 2 3
After treatment:
Pigment score: 0 1 2 3
Visual analogue scale: 0 1 2 3 4 5 6 7 8 9 10
Discomfort: 0 1
Healing score: 0 1 2 3
Others:

Figure (1): Case sheet

Figure (2): WaterlaseIplus 2780 nm USA 2011.

Figure (3): Diode laser 810nm Elexxion Germany 2010.

Figure (4) A - Gingival pigmentation before treatment.
B,C- Immediate result after waterlase laser therapy.
D- Two weeks afterwaterlaselaser therapy.
E- Five weeksafter waterlase laser therapy.

Figure (5) A - Gingival pigmentation before treatment.
B,C- Immediate result after diode laser therapy.
D- Two weeks afterdiodelaser therapy.
E- Five weeksafter laserdiode therapy.