Dental pulp pain in young and postmenopausal women: a pilot study

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SUMMARY

Introduction This pilot study was aimed to compare pulpal pain provoked by electrical and thermal (cold) stimuli in healthy young women during various phases of menstrual cycle and postmenopausal women.

Material and methods The study included 20 regularly menstruating healthy women and 20 postmenopausal women. Electrical (electrical pulp tester) and cold (refrigerant spray) stimuli were performed on mandibular central incisors, twice in regularly menstruating (menstrual and luteal phases) and once in postmenopausal women. Results were expressed as pain threshold values for electrical pulp stimulation (0-80 units) and pain intensity scores (visual numeric scale, from 0 to 10) for cold stimulation.

Results In young women, higher pain electrical threshold (p=0.484) and pain sensitivity score (p=0.015) were observed in luteal in comparison to menstrual phase. In postmenopausal women, electrical pain threshold was significantly higher while pain intensity score was significantly lower than in young women, regardless of the menstrual phase and painful stimuli.

Conclusion Lower responsiveness to dental pulp pain was obtained in young women in luteal phase and postmenopausal women.

Keywords: dental pulp; menstrual cycle; pain; menopause

INTRODUCTION

A large number of clinical and experimental studies on sex differences in various painful conditions have shown their higher prevalence in women [1, 2]. Migraine headache, tension-type headache, fibromyalgia, rheumatoid arthritis, osteoarthritis, irritable bowel syndrome, and temporomandibular disorders (TMD) are more common in women than in man [1, 3-8]. Furthermore, women experience higher pain intensity, pain frequency and longer duration of pain [1, 10]. Women are also more likely to consult physicians because of various pain conditions [1]. Sex differences in pain response can be ascribed to social, neurophysiological, genetic, and immunological influences, as well as to the effects of gonadal hormones.

A large number of findings suggest gonadal hormones may affect pain perception in women [1, 10]. In the lifetime hormonal levels modulate significant changes in clinical pain conditions in women. Namely, TMD and migraine headache usually appear after puberty and peak during the reproductive period, in the 20-45-age range [10]. Pain intensity in TMD, migraine headache, and other painful clinical conditions increases towards the end of the menstrual cycle and during the first days of menstruation [11, 12]. These findings suggest that decrease in estrogen and progesterone levels during perimenstrual phase (decrease in estrogen concentration with rise in progesterone concentration) has also been related to increased migraine pain intensity. Similarly, TMD pain level can increase during ovulation, the phase characterized by the rapid change in estrogen level [11]. Conversely, pain fluctuation during menstrual cycle has not been observed in patients with fibromyalgia [12].

Changes in pain conditions could be expected after the reproductive period due to both ageing process and other medical causes. Studies have shown that in postmenopausal period the prevalence of TMD and migrinous headaches decreases [10], but prevalence of other pain syndromes such as fibromyalgia and osteoarthritis increases [10, 13]. These findings suggest that changes in pain conditions in postmenopausal period depend on the pain modality and characteristics [14]. Unlike clinical pain conditions, it is not yet clear if pain sensitivity on various acute stimuli in healthy women (experimental pain) depends on hormonal status. Namely, several authors have indicated increased pain sensitivity on various stimuli in healthy women during various menstrual phases [15, 16], while others have shown an absence in pain response variability during menstrual cycle [17, 18]. Hormones affect numerous sites for pain sensitivity modulation: primary afferent fibres, spinal cord, brainstem, and cerebrum [19]. As gonadal hormone receptors have been identified throughout the nervous system [20]
it is possible that these hormones affect numerous sites to modulate pain. It has been demonstrated that gonadal hormones interact with nociceptive processes at multiple levels of the peripheral and central nervous system [12, 21]. However, the exact role of gonadal hormones in nociceptive modulation is rather complex and yet not fully understood [22].

Fluctuation in ovarian hormones during menstrual cycle and in various life periods may affect physiological and pathological responses of dental pulp. Namely, estrogen receptors have been detected in the pulp tissue in women in reproductive age, as well as in menopausal women, regardless of age [23]. Also, it has been proven that lower estrogen level during menstrual phase in regularly menstruating and menopausal women is related to lower pulp blood flow [24]. However, according to Tófoli et al. [25], who investigated anaesthetic efficacy and pain induced by dental anaesthesia in regards to menstrual phase, no association between menstrual cycle and investigated parameters of dental anaesthesia has been found, both in healthy regularly menstruating women and women using contraceptives. The influence of hormonal changes during menstrual cycle and postmenopausal period on the pulp pain sensitivity has not yet been investigated. Better insight into these interactions might be of great importance to improve the treatment efficacy.

The aim of this pilot study was to compare the pulp pain response provoked by electrical and thermal (cold) stimuli in young healthy women during various phases of menstrual cycle and postmenopausal women.

MATERIAL AND METHODS

Forty healthy and pain-free women were selected from patients attending yearly routine check-ups, or subjects accompanying the patients referred to the Specialist Clinic of Faculty of Medicine, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina. The subjects were divided into the two groups: the group of regularly menstruating women (menstrual cycle defined as varying between 26 and 28 days), aged 20 to 40 years (mean age 32.8±5.9) (n=20), and the group of postmenopausal women (at least 2 years after menopause), aged 50 to 65 years (mean age 59.6±4.4) (n=20). The inclusion criteria were: the presence of Srpska, Bosnia and Herzegovina. The subjects were divided into the two groups: the group of regularly menstruating and menopausal women. Further criteria were no known medical condition, pregnancy, intake of oral contraceptives, any medications, crowns or veneers and tooth wear, without pulp and periodontal disease. Further criteria were no known medical condition, pregnancy, intake of oral contraceptives, any drugs on a regular basis or any medications that could alter blood flow [24]. However, according to Tófoli et al. [25], who investigated anaesthetic efficacy and pain induced by dental anaesthesia in regards to menstrual phase, no association between menstrual cycle and investigated parameters of dental anaesthesia has been found, both in healthy regularly menstruating women and women using contraceptives. The influence of hormonal changes during menstrual cycle and postmenopausal period on the pulp pain sensitivity has not yet been investigated. Better insight into these interactions might be of great importance to improve the treatment efficacy.

The aim of this pilot study was to compare the pulp pain response provoked by electrical and thermal (cold) stimuli in young healthy women during various phases of menstrual cycle and postmenopausal women.

RESULTS

Table 1 shows the frequency of pulp response to the applied stimuli. The reaction of the pulp to electrical stimuli was observed in all subjects and in all periods of measurement. On the other hand, the number of teeth

| Group                        | Electrical test | Cold test |
|------------------------------|----------------|-----------|
|                              | n (%)          | n (%)     |
| Regularly menstruating women |                 |           |
| Menstrual phase               | 20 (100)       | 20 (100)  |
| Menstrual faza                |                |           |
| Postmenopausal women          | 20 (100)       | 13 (65)*  |

*p = 0.008 compared to menstrual phase in regularly menstruating women

*p = 0.008 u odnosu na menstrualnu fazu kod žena sa redovnim menstrualnim ciklusom
that were responsive to cold stimulation was lower in postmenopausal women (65%) compared to women in menstrual (100%; p = 0.008) and luteal phase (85%) of the cycle.

Mean values and standard deviations (SD) of stimulus threshold and intensity of pain in studied groups are shown in Graphs 1 and 2. The sensitivity analysis in the pulp with respect to the cycle phase showed greater pulp sensitivity to electrical (lower threshold level) and cold stimuli (higher pain intensity) in the menstrual compared to the luteal phase, however, the difference was statistically significant only for cold stimulation (p = 0.015). The pulp in postmenopausal women showed significantly higher threshold level to electric stimulus and significantly lower pain intensity to cold stimulus compared to women with regular menstrual cycle, regardless of the cycle phase (Graphs 1 and 2).

DISCUSSION

In order to clarify the possible influence of gonadal hormonal fluctuations on pain sensitivity of the pulp, the current research examined the effects of electric and cold stimuli in women of reproductive age, within two phases of menstrual cycle (menstrual and luteal), and postmenopausal women. The results showed that luteal phase in women with regular menstrual cycle characterized by high levels of gonadal hormones, and menopause - a period of chronic reduction in the level of gonadal hormones, are periods of lower pulp sensitivity.

In our study, pulpal pain was induced by electric and cold stimuli in healthy women without the presence of other painful conditions (experimental pain model). Evaluation of pain sensitivity in healthy subjects is important for investigation of various aspects of mechanisms that underlie pain. Sensory manifestations and sensory-motor interaction of previously clearly defined pain can be determined on experimental pain model. Moreover, experimental pain model is valuable for pharmacological and clinical studies in order to quantify the sensitivity of the nociceptive system in pain patients, as well as to predict clinical pain and clinical pain outcomes [26]. Research on sensitivity of healthy women to various stimuli during menstrual cycle have not given clear evidence of experimental pain hormonal dependence [12, 27]. Some authors have found that pain perception varies during the cycle [15, 16], while others have not confirmed a link between pain and hormonal fluctuations during the cycle [17, 18]. Discrepancies in results can be attributed to methodological differences, such as type of observed experimental pain, stimulated tissue, a measuring outcomes (threshold or intensity) and functional division of the menstrual cycle with no measurement of gonadal hormone concentrations [12, 27]. An interesting fact is that the brain cortex activity induced by experimental painful stimuli varies between menstrual phases with high levels of estrogen and phase characterized by low hormone levels, and these changes are not always accompanied by altered response to pain [28]. Unlike the experimental pain, it has been shown that pain in certain clinical pain conditions varies during menstrual cycle [10]. In these patients, many other factors can influence the perception of pain during menstrual cycle. Also, patients with pain conditions may have altered sensitivity to hormonal changes during the cycle.

The current study investigated the pulp reaction to electrical and cold stimuli. Electric pulp test and cold test using cold spray are the most frequently used tests for investigation of pulp sensitivity [29]. Various types of stimuli have been applied in experimental studies that investigate the relationship between hormonal status and pain and its characteristics. It has been observed that various stimuli differently activate nociceptive afferent fibres in the tissue. Electric stimuli trigger all classes of afferent neurons, while thermal stimuli only A-δ and C fibres [30]. Also, certain types of stimuli can cause stress, while others activate endogenous regulatory mechanisms of pain. Therefore, hormonal status can have different effects on different stimuli. In fact, it has been shown that menstrual cycle has opposite effect on pain caused by electrical stimulus from pain caused by other painful stimuli (pressure, cold, warm, ischemic pain) [31]. In our study, higher pulp sensitivity to electrical as well as to cold stimulation was observed in the menstrual phase. Although various groups of nerve fibres contribute in the occurrence of various types of pain, in dentin-pulp complex both stimuli cause
activation of peripherally placed A-δ fibres that are mediators of sharp, localized pain. Centrally positioned C fibres that are responsible for the appearance of dull, long-term pain were not activated during testing, unless greater intensity of electricity was applied or there was an irritation that caused tissue damage. It is important to note that in addition to the type of stimulation, pain sensitivity varies on the type of tested tissue and the depth of tissue to which the stimulus is applied [15].

In women of reproductive age increased pain sensitivity, especially to cold stimulation, was recorded during menstrual phase, phase characterized by low levels of estrogen and progesterone, while lower sensitivity was present during luteal phase when estrogen and progesterone levels were high. Gonadal hormones, estrogen and progesterone, can express pronociceptive as well as antinociceptive effects depending on the overall hormonal profile [12]. It is believed that at the end of luteal and in early follicular phase, when the levels of both gonadal hormones are low, sympathetic tone, inflammatory response, the synthesis of prostaglandins and affective symptoms reach their highest level, while descending inhibitory systems are at the lowest level [12]. This explains why perimenstrual phase is period of increased sensitivity to various painful conditions. On the other hand, in the middle luteal phase, gonadal hormones reduce pain sensitivity through increased GABA-tic tone and increased cortisol secretion [12]. These mechanisms could explain differences in pulp sensitivity during investigated periods of menstrual cycle observed in the current study.

Compared with reproductive age women, in menopausal women sensitivity of pulp was lower, regardless of the applied stimulus and the phase of cycle. Although the influence of gonadal hormones in the reproductive age on clinical pain conditions is somewhat clarified, data on their impact in menopause are different [27]. A study that compared the incidence of various painful conditions in menopausal women with premenopausal period, has found that menopausal changes depend on the type and characteristics of pain [14]. Headaches and cervical / lumbar pain decreased or even disappeared, while developed or intensified joint pain affected more than half of women. Pain intensity and painful area also change with menopause. In most of the cases, high intensity pain that would affect larger area remained unchanged or decreased, while low intensity pain and pain that affects smaller area increased [14]. The impact of ageing process on the pulp tissue and its sensitivity should not be ignored. Reduction of painful pulp reactions in elderly is attributed to reduction in number of nerve fibres, creation of secondary and tertiary dentin and tubule occlusion [32]. However, significant impact of age on dental pulp response caused by electrical stimulation was not found [33, 34]. Reaction to electrical test was obtained in all subjects, in women of reproductive age as well as menopausal women. On the other hand, it has been shown that the sensitivity of pulp to cold stimuli decreases with age [35]. Unlike electrical test, which is dependent on the ions movement, cold stimulus causes pain response by dentinal fluid movement [36], which can partly explain reduction of pulp sensitivity to cold in menopausal women. In the current study response to cold stimulation was not obtained in 35% of menopausal women even after two repeated measurements. An interesting finding is that the application of cold spray caused a painful reaction in all subjects in the menstrual phase, but not in 15% of subjects in the luteal phase, what could be misinterpreted in clinical conditions as a loss of tooth vitality. Studies have shown that the response of dental pulp to cold stimulation is the most reliable in this particular age group (21-50 years) [29]. Findings of decreased pain sensitivity in the luteal phase of menstrual cycle characterized by high levels of sex hormones, as well as reduced sensitivity during menopause, a period of chronic reduction in the levels of gonadal hormones, suggest that if there is an association between gonadal hormone levels and pain sensitivity, it is not simple.

Potential variations were not examined in this study. Namely, the division of menstrual cycle in phases was performed on the basis of medical history, without measurement of gonadal hormone concentration. Measuring gonadal hormones levels is important for precise determination of menstrual cycle phase, as well as in determining the correlation between hormonal levels and painful response. However, only a few studies have investigated the influence of gonadal hormone concentration on experimental pain until now. Secondly, sensitivity of the pulp is measured only in the two phases of menstrual cycle. However, to determine the relationship between hormonal status and pain, a research should include more cycle phases.

CONCLUSION

The results of this pilot study indicate correlation between pulp pain and menstrual cycle. Higher sensitivity of the pulp to cold stimulus was recorded in the menstrual phase compared to the luteal phase. Pulp sensitivity in menopausal women was reduced regardless of the type of stimulus and cycle phase.

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Pulpni bol kod žena u reproduktivnoj dobi i menopauzi: pilot studija

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KRATAK SADRŽAJ

Uvod Cilj ovog pilot istraživanja je bio da se ispita pulpni bol izazvan delovanjem električnog i hladnog nadražaja kod žena u reproduktivnoj dobi i menopauzi kao različitim fazama menstrualnog ciklusa.

Materijal i metode rada U istraživanju je uključeno 20 zdravih žena sa redovnim menstrualnim ciklusom i 20 zdravih žena u menopauzi. Sostavljena je grupa žena sa redovnim menstrualnim ciklusom i grupa žena sa smanjenim menstrualnim ciklusom.

Rezultati Godine života, značajni su uključeni u ovaj proces.

Zaključak Manja osećajnost pulpe kod žena u reproduktivnoj dobi i menopauzi.

Ključne reči: bol; menopauza; menstrualni ciklus; zubna pulpa

UVOD

Brojna klinička i eksperimentalna istraživanja o povezanosti pola i različitih bolnih stanja je ukazala na njihovu čестo pojavu kod žena [1,2]. Migrenozne i tenzionate glavobolje, fibromialgija, reumatoidni artritis, artritis, sindrom iritabilnog kolona i temperatura poromandibularne disfunkcije (TMD) često se javljaju kod žena u porodičnoj skupini [1,3–8]. Takođe, kod žena sa redovnim menstrualnim ciklusom, nivo estrogena u menstrualnoj fazi kod žena sa redovnim ciklusom nije uočen značajan uticaj menstrualnog ciklusa na ispitivane parametre [9,10]. U svim faziama menstrualnog ciklusa, bolesti pulpe izazvane su uključenim delovanjem električnog i hladnog nadražaja kod žena u reproduktivnoj dobi i menopauzi.

Varijacije polnih hormona tokom menstrualnog ciklusa i menstrualnog ciklusa kod žena na nadražaje tokom različitih faza menstrualnog ciklusa [15,16]. Ovo se utvrđuje sa istraživanja u kojima se značajno smanjenja nalazi kod žena sa redovnim menstrualnim ciklusom, kod žena u menopauzi i kod žena sa redovnim menstrualnim ciklusom [11,12]. Osim toga, kod žena u menopauzi, značajni se nalazi kod žena u uvećanom vartu, sa istraživanja kod žena u reproduktivnoj dobi i menopauzi.

Za razliku od kliničkih bolnih stanja, još uvek nije jasno da li je bolna osećajnost na različite akutne nadražaje kod žena izazvan od hormonalnog statusa. Naime, pojedini autori ukazuju na povećanu osećajnost zdravih žena na nadražaje tokom različitih faza menstrualnog ciklusa [15,16], dok drugi na odsustvo varijabilnosti u odgovoru na nadražaje tokom menstrualnog ciklusa [17,18]. Modulacija žena se odvija na više nivoa: primarnim aferentnim vlaknima, kičmenoj moždini, moždanom stablu i mozgu [19]. Receptori za polne hormone se nalaze u nervnom sistemu [20], što ukazuje na moguću uticaj hormona na različite strukture nervnog sistema. Istraživanja su dokazala da polni hormoni interaguju sa nociceptivnim procesom na više nivoa i u perifernom i centralnom nervnom sistemu [12,21]. Ipak, uloga polnih hormona u nociceptivnoj modulaciji je kompleksna i još uvek nije u potpunosti razjašnjen [22].

Varijacije polnih hormona tokom menstrualnog ciklusa i menstrualnog ciklusa kod žena u reproduktivnoj dobi, kao i u pulpi žena u menopauzi, koje je bolna osećajnost na različite nadražaje kod žena na nadražaje tokom različitih faza menstrualnog ciklusa [15,16]. Ovo se utvrđuje sa istraživanja kod žena u reproduktivnoj dobi i menopauzi.

Promene u osećajnosti pulpe kod žena u reproduktivnoj dobi i menopauzi uključuju delovanje električnog i hladnog nadražaja kod žena u reproduktivnoj dobi i menopauzi. Ovo se utvrđuje sa istraživanja kod žena u reproduktivnoj dobi i menopauzi, koje su ukazale na njihovu češću pojavu kod žena u reproduktivnoj dobi i menopauzi.

Cilj istraživanja je bio da se ispita pulpni bol izazvan delovanjem električnog i hladnog nadražaja kod žena u reproduktivnoj dobi i menopauzi.
MATERIJAL I METODE RADA

Ispitivanjem je obuhvaćeno 40 žena koje su se javile u Specijal- stički centar Medicinskog fakulteta Univerziteta u Istočnom Sa- rajevu, Republika Srpska, Bosna i Hercegovina, radi kontrolnog pregleda ili kao pratnja osoba sa zakazanim stomatološkom intervencijom. Ispitanice su podeljene u dve grupe: grupa žena sa redovnim menstrualnim ciklusom (trajanje menstrualnog ciklusa između 26 i 28 dana), starosti od 20 do 40 godina (pro- sečna starost 32,8 ± 5,9) (n = 20) i grupa žena u menopauzi (najmanje dvije godine od početka menopauze) starosti od 50 do 65 godina (prosečna starost 59,6 ± 4,4) (n = 20). Kriterijumi za uključivanje u studiju su bili: postojanje klinički in- taktog donjeg centralnog sekutića (bez karijesa, restauracija, fiksne nadoknade i bez znakova zubnog trošenja) bez znakova i simptoma znakova oštećenja pulpe i apeznog periodoncijuma. Žene sa sistemskim oboljenjima, žene u toku trudnoće, one koje se nalaze na hormonskoj ili drugoj terapiji ili koje su uzimale lekove koji utiču na percepciju pulpe (zaključno pre početka istraživanja) su isključene iz učestvovanja. U istraživanje su uključene ni one ispitnice kod kojih je neposredno pre početka istraživanja zabeležena onog simptoma kliničkog oštećenja pulpe. Od svake ispitnice u istraživanje je uključen samo jedan zub. Ispitanice sa redovnim menstrualnim ciklusom su ispitane dva puta: u toku menstrualne (1–5. dan ciklusa) i lutealne faze (17–23. dan ciklusa) menstrualnog ciklusa, a žene u menopauzi jednom. Osetljivost pulpe je ispitana na električni i hladni stimuli. Pre istraživanja pulpe je izolovan vaterolnak i posušen. Pulpa kod žena u menopauzi je prikazana u obliku srednjih vrednosti i standardnih devijacija (SD) za numerička, odnosno učestalosti za atributivna obeležja. Pulpa kod žena sa redovnim menstrualnim ciklusa ispituje manje osetljivost pulpe. Pulpa kod žena u menopauzi je prikazana u obliku srednjih vrednosti i standardnih devijacija (SD) za numerička, odnosno učestalosti za atributivna obeležja. Pulpa kod žena u menopauzi je prikazana u obliku srednjih vrednosti i standardnih devijacija (SD) za numerička, odnosno učestalosti za atributivna obeležja.

DISKUSIJA

Kako bi se razjasnio mogući uticaj fluktuacije polnih hormona na bolnu osetljivost pulpe, pa kvalitet trake i hitre dijagnostike, osetljivost pulpe na električnu i hladnu stimuli, postoji nekoliko različitih aspekata mehanizma koji se nalaze u osnovi osetljivosti pulpe. Pulpe kod žena u menopauzi je prikazana u obliku srednjih vrednosti i standardnih devijacija (SD) za numerička, odnosno učestalosti za atributivna obeležja. Pulpe kod žena u menopauzi je prikazana u obliku srednjih vrednosti i standardnih devijacija (SD) za numerička, odnosno učestalosti za atributivna obeležja.
koju karakteriše nizak nivo hormona, i da te promene nisu uvek pružene promenjenim odgovorom na bol [28]. Za razliku od eksperimentalnog bola, dokazano je da bol kod određenih kliničkih bolnih stanja varira tokom menstrualnog ciklusa [10]. Kod ovih pacijenata brojni drugi faktori mogu da utiču na percepciju bola tokom menstrualnog ciklusa. Takođe, pacijenti sa bolnim stanjima mogu imati izmjenjenu osetljivost na hormonale promene tokom ciklusa.

U ovom istraživanju je ispitivana reakcija pulpe na električnu i hladnu stimulaciju. Elektrotest i test na hladno, primenom hladnog spreja, najčešće su primenjivani testovi za ispitivanje osetljivosti pulpe [29]. Različite vrste stimulansa se primenjuju u eksperimentalnim istraživanjima koja istražuju povezanost hormonalnog statusa sa bolom i njegovim karakteristikama. Uočeno je da različiti nadražaji različito aktiviraju aferentna nociceptivna vlakna u tkivima. Električni aktiviraju sve klase aferentnih neurona, a termalni stimulansi samo A-δ i C vlakna [30]. Takođe, pojedine vrste nadražaja mogu izazvati stres, dok druge aktiviraju endogene regulatorne mehanizme bola. Stoga, hormonalni status može imati različite efekte na različite stimulanske načine. Naime, pokazano je da menstrualni ciklus ima suprotni efekat na električnim nadražanjem izazvanim bolom od bola koji izazivaju drugi bolni stimulansi (pritisak, hladno, toplo i ishemički bolni stimulansi) [31]. U ovom istraživanju veća osetljivost pulpe i na električnu i na hladnu stimulaciju je uočena u menstrualnoj fazi. Iako različite grupe nervnih vlakana doprinose nastanku različitih vrsta boli, oba stimulansa u pulp-dentinskom kompleksu izazivaju aktivaciju periferno postavljenih A-δ vlakana, koja su mediatori oštrog, lokalizovanog boli. Centralno pozicionirana C vlakna, koja su odgovorna za pojavu tupog, dugotrajnog boli, ne aktiviraju se prilikom testiranja, osim ukoliko se ne primeni struja većeg intenziteta i oni koji su zahvatili manje područje pogoršali [14]. Ipak, nije pokazan značajan uticaj godina na reakciju zubne pulpe u zglobovima u više od polovine žena. Intenzitet i bolni odgovor su smanjeni u lutealnoj fazi menstrualnog ciklusa, dok su se bolovi slabog intenziteta i oni koji su zahvatili manje područje pogoršali [14].

Ne treba zanemariti uticaj samog procesa starenja na tkivo i njenu osetljivost. Smanjenje bolnih promena pulpe i menstrualnog ciklusa kod starijih osoba se pripisuje redukciji broja nervnih vlakana, stvaranju sekundarnog i tercijarnog dentina, kao i oštećenju tubula [32]. Ipak, nije pokazan značajan uticaj godina na reakciju zubne pulpe na hladno stimulans [33, 34]. Elektrotestom reakcija je dobijena kod svih ispitanica, i žena u reproduktivnoj dobi i žena u menopauzi. Sa druge strane, pokazano je da se osetljivost pulpe na hladno smanjuje sa starenjem [35]. Za razliku od elektrotesta, koji je zasnovan na kretanju jona, hladni stimulans izaziva bolnu reakciju kretanjem dentinskog likvora [36]. Kao gubitak vitaliteta zuba. Istraživanja pokazuju da je reakcija zubne pulpe na hladnu stimulaciju najpoznavljena baš u ovoj starosnoj dobi (21–50) godina [29]. Uzimajući u obzir postojanje osetljivosti pulpe na hladno stimulans, posmatraju se pripisuje redukciji broja nervnih vlakana, stvaranju sekundarnog i tercijarnog dentina, kao i oštećenju tubula [32]. Polni hormoni, estrogen i progesteron, mogu da ispolje i pronociceptivne i antinociceptivne efekte, što zavisi od celokupnog hormonskog statusa sa bolom osetljivosti pulpe i na električnu i na hladnu stimulaciju. Intenzitet i bolni odgovor su smanjeni ili su se smanjili, dok su se bolovi slabog intenziteta i oni koji su zahvatili manje područje pogoršali [14].

Veličini broj potencijalnih varijabli nije ispitan u ovom istraživanju. Naime, podela menstrualnog ciklusa na faze je sprovedena na osnovu anamnestičkih podataka, bez kvantifikacije polnih hormona. Merenje koncentracije polnih hormona je od značaja, kako zbog preciznog određivanja faze menstrualnog ciklusa, tako i za određivanje korelacije između nivoa hormona i bolnih odgovora. Ipak, samo u nekoliko studija do sada je izmislio uticaj koncentracije polnih hormona na eksperimentalni bol. Takođe, osetljivost pulpe je merena samo u dve faze menstrualnog ciklusa. Ipak, za utvrđivanje povezanosti hormonalnog statusa sa bolom ispitivanje treba da obuhvati veći broj ciklusnih faza.

ZAKLJUČAK

Rezultati ove pilot studije ukazuju na povezanost između pulpnog boga i menstrualnog ciklusa. Veća osetljivost pulpe na hladni stimulans je zabeležena u menstrualnoj fazi u poredenju sa lutealnom fazom. U odnosu na žene u reproduktivnoj dobi, osetljivost pulpe kod žena u menopauzi je smanjena, nezavisno od vrste nadražaja i faze ciklusa.