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A Comparative Study on Urinary Incontinence to Improve Pelvic Floor Strength in The Female Population with Pelvic Floor Dysfunctions Embryological K-Cat Concept Based Exercises Versus Traditional Pelvic Floor Exercises

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ABSTRACT

Urinary Incontinence is an involuntary and uncontrolled leakage of urine mostly due to detrusor overactivity. Studies indicate that 9% to 39% of women experience daily urinary incontinence. In women over 60 years of age one out of three women experience urinary incontinence. Different types of urinary incontinence are seen such as stress, urge, mixed, overflow and functional. Many factors seem to influence the rate of leakage such as sneezing, coughing, physical activity. In most cases except neurological conditions and tumors, urinary incontinence presented along with pelvic floor dysfunction which is categorized as either hyperactivity of pelvic floor muscles or hypertonicity and lastly overactivity of pelvic floor muscles. In most studies it has been evident that state of pelvic floor muscles can cause urinary incontinence. This study will help us identify the efficacy of traditional exercises which are readily practiced in managing urinary incontinence simultaneously comparing with K-CAT based exercises which are more advanced and logical approach in managing urinary incontinence by using different connections of pelvic floor commonly seen with breathing and jaw positioning.[i]

Background: Urinary incontinence (UI) is a common issue among women, often caused by pelvic floor dysfunction. While traditional pelvic floor exercises are commonly prescribed, emerging approaches such as the Embryological neural tube continuity through Jaw & Pelvis concept offer a novel perspective by targeting the functional linkage between the anterior and posterior neuropore through the continuity and the diaphragmatic connection well established in adult through breathing (pressure gradient difference management).

Objective: To assess the effectiveness of Embryological Jaw & Pelvis connection in managing urinary incontinence in women with pelvic floor dysfunction.

Methods: A total of 60 female participants aged 30 to 60 years with urinary incontinence were enrolled and treated using the embryologicalJaw & Pelvis connection for 12 weeks or 3 months. The outcomes were evaluated using the 1-hour pad test and post-void residual (PVR) volume measured through ultrasonography. Pre- and post-treatment comparisons were analyzed using paired t-tests.

Keywords: *Urinary Incontinence, jaw & pelvis Concept, Pelvic Floor Dysfunction, Pad Test, Post-Void Residual, Fascial Connections, K-CAT, K-CAT pelvic floor exercise, long exhalation, neural tube, gluteal squeeze.*

1. INTRODUCTION

Urinary incontinence (UI) is a widespread and distressing condition characterized by the involuntary leakage of urine, often resulting in significant social, psychological, and physical distress among affected individuals. It can stem from various underlying causes, including pelvic floor dysfunction, neuromuscular impairment, detrusor overactivity, or anatomical variances. Subtypes such as stress urinary incontinence (SUI), urge urinary incontinence (UUI), mixed incontinence, overflow incontinence, and functional incontinence reflect the complexity of its etiology and manifestation [1].

The pelvic floor plays a crucial role in urinary incontinence, forming a supportive sling composed of muscles, ligaments, and fascia that spans from the pubic symphysis anteriorly to the coccyx posteriorly. It provides structural support to the bladder, uterus, and rectum while contributing to urethral and anal sphincter function. Dysfunction of the pelvic floor muscles (PFMs)—including hypertonicity, hypotonicity, or incoordination—can significantly impair continence mechanisms [2].

Traditional rehabilitation approaches emphasize strengthening of the PFMs through well-established pelvic floor muscle exercises (PFMEs). These are shown to be effective, particularly for stress and mixed UI, and outcomes are enhanced under supervised programs [3]. However, despite their widespread use, conventional PFME protocols may not fully address the deeper integrative and systemic connections that influence pelvic floor dynamics.

Emerging research has begun to highlight the role of fascial continuity and embryological development in pelvic floor function. During embryogenesis, particularly around day 15 of development during gastrulation, two crucial depressions—the oropharyngeal membrane and the cloacal membrane—form on the dorsal aspect of the embryo. These structures later give rise to the mouth and the urogenital and anorectal openings, respectively. Importantly, they remain linked by a continuous midline axis, around which the notochord and neural tube develop [4]. This anatomical continuity underpins the notion that the jaw and pelvic floor, despite their spatial separation, share developmental origins and retain functional connectivity.

The fascial system further reinforces this embryological relationship. Fascia is a dense connective tissue that envelops muscles, nerves, and organs, maintaining continuity across the body. A myofascial and neuromyofascial connection has been proposed between the stomatognathic system (jaw) region and the pelvic diaphragm through the deep front line, involving structures such as the thoracolumbar fascia, iliopsoas, and diaphragm [5]. Studies also suggest that tension or dysfunction in the temporomandibular joint (TMJ) may reflect or induce dysfunctions in the pelvic region, mediated via fascial and dural connections [6].

The role of craniosacral system offers another lens to understand this linkage. The dural tube, a protective membrane encasing the brain and spinal cord, extends from the cranial base to the sacrum. This fascial system allows bidirectional communication between cranial and pelvic structures. Therefore, dysfunction in the jaw, such as bruxism or TMJ disorders, may lead to tension imbalances that propagate to the sacral region, affecting pelvic floor tone and urinary control [7].

The K-CAT (Kinetic Chain Activation Technique) concept is a novel integrative approach grounded in this embryological and fascial understanding. It focuses on activating the pelvic floor through interconnected zones like the jaw, diaphragm, and sacrum. K-CAT incorporates forceful exhalation, postural awareness, and targeted fascial engagement to restore neuromuscular control of the pelvic diaphragm. By leveraging embryological connections and the kinetic chain, this concept seeks to optimize functional rehabilitation outcomes beyond traditional pelvic floor strengthening [8]. Thus, one of the many benefits of K-CAT over traditional interventions is its simplicity. It is functional and requires no equipment. The patient is capable of performing exercise on their own without much dependence on the therapist.

Moreover, emotional and psychological dimensions also influence the fascial system. Chronic stress, unresolved trauma, and emotional repression are often stored somatically in areas like the jaw and pelvis, manifesting as muscle tightness or dysfunction. Emotional clenching of the jaw is often mirrored by holding patterns in the pelvic floor, indicating a psychosomatic link supported by both somatic experiencing and myofascial research [9]. The integration of breathwork and emotional regulation in K-CAT aims to address this biopsychosocial triad.

Given these interconnected systems, a more holistic approach is warranted. This study aims to evaluate the efficacy of embryologically connected fascial chain–basedconnection between jaw & pelvis which is a base for pelvic floor strengthening in managing urinary incontinence in women with pelvic floor dysfunction. By focusing on both the anatomical and functional continuum from the jaw to the pelvis, the study seeks to advance the paradigm of pelvic rehabilitation.

2. BACKGROUND

Urinary incontinence is a common health issue that affects millions of women globally. It is characterized by the involuntary leakage of urine and can significantly impact emotional well-being, social interactions, and quality of life. Various types of urinary incontinence exist, including stress urinary incontinence, which occurs during physical activity; urge urinary incontinence, marked by a sudden, intense need to urinate; mixed urinary incontinence, which combines both stress and urge elements; overflow incontinence, which involves the inability to fully empty the bladder; and functional incontinence, caused by physical or environmental barriers that hinder timely access to toilet facilities (10).

In women, urinary incontinence is often associated with dysfunction of the pelvic floor muscles, a complex group of muscles that support the pelvic organs including the bladder, uterus, and rectum. Weakness or improper coordination of these muscles can result from aging, childbirth, menopause, and sedentary lifestyles, thereby impairing continence mechanisms. For many years, the conventional approach to treating urinary incontinence has been isolated pelvic floor muscle training. This method, though effective in improving symptoms, may overlook the body's broader structural and functional connections (11,12).

Recent anatomical and biomechanical studies have underscored the importance of fascial and embryological connections that link distant body regions. One such relationship that has gained attention is the functional and anatomical interplay between the jaw and pelvis. This connection is supported by both fascial continuities and embryological origins, suggesting that dysfunction in one area can influence the other (13,14).

The concept of myofascial meridians, popularized in contemporary manual therapy, suggests that muscular and fascial tension in one region may transmit force and affect function in a distant region. Notably, one such fascial line extends from the jaw down to the pelvic floor. This line includes the tongue, hyoid, cervical fascia, thoracolumbar fascia, and pelvic fascia, offering a mechanical pathway by which tension in the jaw region may influence pelvic muscle tone and function where it is already supported by te embryological evidence (6,7).

The continued anatomical alignment of these structures suggests a deep, persistent relationship between cranial and pelvic regions (15,16).

Furthermore, the craniosacral system illustrates another connection. The dura mater, the outermost membrane surrounding the brain and spinal cord, runs uninterrupted from the skull to the sacrum. Any dysfunction or imbalance at the cranial end, such as jaw tension from clenching or temporomandibular joint dysfunction, can be transmitted along the spinal column to the pelvic region. This can result in altered neuromuscular control, pelvic floor tightness or hypotonicity, and even contribute to urinary incontinence (10).

Emotions also serve as a bridge between the jaw and pelvis. The jaw is a known site for emotional expression and suppression, often becoming tense during periods of stress, anxiety, or anger. Similarly, emotional suppression can lead to increased tone or guarding in the pelvic floor muscles. Both regions serve as somatic mirrors of psychological states. This dual storage of stress and trauma may lead to persistent dysfunction unless addressed holistically (17).

Traditional rehabilitation methods targeting the pelvic floor in isolation may therefore be insufficient in cases where interconnected systems are involved. A deeper understanding of how cranial tension, jaw alignment, spinal posture, and pelvic muscle dynamics are linked could offer a more comprehensive and sustainable approach to treating urinary incontinence. Integrating cranial and sacral assessments cum treatment with pelvic floor rehabilitation may enhance outcomes by addressing the root causes of neuromuscular imbalances.

This emerging perspective emphasizes the necessity of viewing the body as an integrated whole. By recognizing the jaw-pelvis connection through fascial, embryological, neurological, and emotional channels, clinicians and researchers can develop more effective treatment strategies for urinary incontinence and related pelvic floor dysfunctions.

3. OBJECTIVE

To assess the effectiveness of a therapeutic protocol targeting the fascial and biomechanical connection between the jaw and pelvis in improving urinary incontinence symptoms among adult women, by evaluating changes in pad weight and post-void residual volume before and after the intervention.

Inclusion Criteria

- Female participants aged 30 to 60 years.
- Diagnosed with urinary incontinence (stress, urge, or mixed).
- Experiencing symptoms for at least 3 months.
- Willing to provide informed consent and participate throughout the study duration.
- Capable of understanding and following exercise instructions.

Exclusion Criteria

- History of pelvic surgery in the last 6 months to 1 year.
- Presence of urinary tract infections or bladder pathologies (e.g., tumors, stones).
- Neurological disorders affecting bladder control (e.g., multiple sclerosis, spinal cord injuries).
- Cognitive impairment or psychiatric illness that interferes with following instructions.

- Pregnant or postpartum within 6 months.
- Participants currently enrolled in another pelvic rehabilitation program.

Study Design

- **Study Type:** Experimental, interventional study.
- **Design:** Two-arm comparative interventional study with pre-test and post-test design.
- **Sample Size:** 60 participants.
- **Intervention Duration:** 12 weeks or 3 months.
- **Group I (Control):** Received standard core strengthening and pelvic floor rehabilitation exercises.
- **Group II (Experimental):** Received interventions focused on releasing fascial tension and biomechanical realignment targeting the jaw-pelvis connection (e.g., forceful exhalation with jaw positioning, craniosacral release techniques (Dural Chain).
- **Definition of study subjects**: female with pelvic floor dysfunction age between 30 to 60 suffering from urinary incontinence with no other comorbidities or pathology as mentioned in exclusion criteria. All the subjects will be selected after obtaining prior consent and information.

Study sample design – purposive sampling method

Parameters used for comparison and statistical analysis used: paired t- test

Duration of study: 12 weeks or 3 months.

Methodology: Total 60 females will be selected between age 30 to 60 suffering with urinary incontinence and pelvic floor dysfunction after obtaining informed consent all 60 females.

Outcome Measure

1-hr PAD Test: By weighing the used pads after using them for whole day and preventing them from evaporating by keeping them into zip lock after use then all the pads are weighed down and according to weight the outcome is measured.

Mild: 5 to 15g

Moderate: 15 to 30g

Severe: 30 to 50g

Pre and post void sonography: sonography is done to assess urinary incontinence and pre PVR values are recorded after the whole treatment post usg is done to evaluate post PVR values.

A PVR (postvoid residual) of less than 100 mL is considered normal.

Up to 200 mL may be acceptable.

A PVR exceeding 200 mL indicates incomplete bladder emptying.

Over 300 mL suggests urinary retention.

More than 400 mL is classified as urinary retention.

Procedure

Group A: for 12 weeks

Week 1-2:

- cat cow exercise
- clamshell
- pelvic tilt
- isometrics for rectus abdominus and transverse abdominus
- Swiss ball exercises
- deep breathing

Week 3-4:

- posterior pelvic tilt with Kegel activation

- transverse abdominus march
- transverse abdominus heel drop
- bent knee fall out
- dead bugs
- bird dogs

Week 5-6:

- cycling on level surface
- gentle aerobics
- light weights
- semi squat with wall support
- resisted clamshells
- bridging

Week 7-8:

- brisk jogging
- single leg pelvic bridging
- supine march
- sidestepping with pelvic floor contraction with Thera loop
- squat at 90^0 positions
- Kegel exercises

Week 9-10:

- full squats with wall support
- single leg pelvic bridging with weights
- swimming
- jogging
- cycling
- jumping jacks

Week 11-12:

- full functional activities with assessment and follow ups

Group B (K-CAT Concept Exercise Protocol)

For 12 weeks:

Week 1 – Blowing exercise (K-CAT exercise) on physioball.

Week 2 - Blowing exercise on physioball with integrated awarness of neural tube fascial connection.

Week 3- Forceful blowing exercise with progression on physioball with integrated awarness of neural tube fascial connection.

Week 4 – Above exercise with more control along with sensory cues to involve gluteal muscles.

Week 5 – continue exercise of 4th week with gluteal squeeze in standing position.

Week 6 – same as week 5 with automated squeeze with support.

Week 7 – same as week 6 squat without support.

Week 8 – same as week 7 with 45 degree squat

Week 9 – same as week 8 with 90 degree squat

Week 10- same as week 9 with full squat in functional position (as it varies in Asian population)

Week 11 – increasing more control in functional position in this week.

Week 12 - same as week 11 progressing with increased repetitions (as achieving the master of all maneuvers) until the symptoms resolve.

4. RESULTS & TABLES

Table 1: Total Pre and Post PVR Distribution According to Age Distribution

	Pre PVR		Post PVR		
Age Group	Mean	SD	Mean	SD	P value
31-40 (18)	235.94	63.02	136.22	52.37	<0.001 (HS)
41-50 (18)	280.50	70.77	138.00	43.92	<0.001 (HS)
51-60 (24)	308.00	61.12	171.29	62.73	<0.001 (HS)
Total	278.13	70.36	151	56.42	<0.001 (HS)

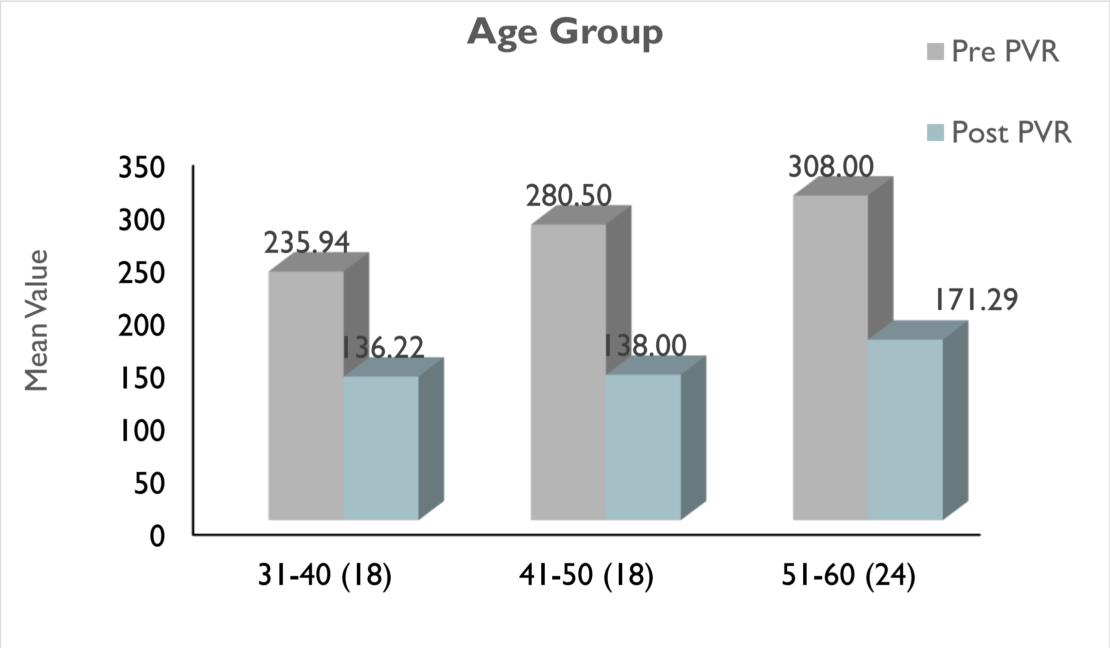
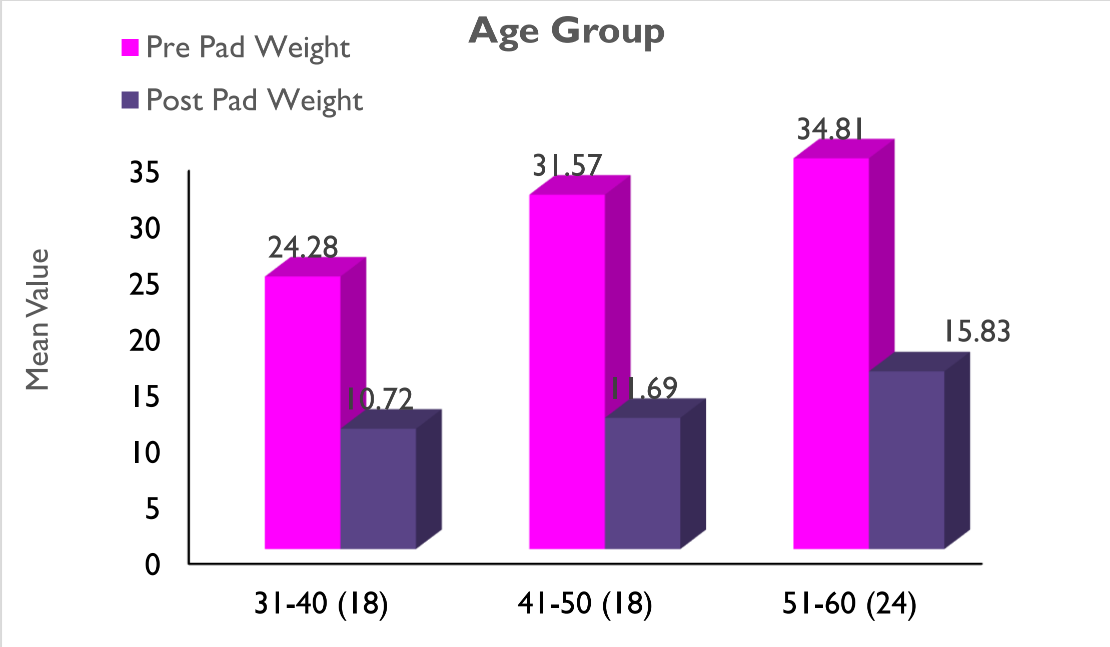


Table 2: Total Pre and Post Pad Weight Distribution According to Age Distribution

	Pre Pad Weight		Post Pad Weight		
Age Group	Mean	SD	Mean	SD	P value
31-40 (18)	24.28	9.53	10.72	7.62	<0.001 (HS)
41-50 (18)	31.57	9.90	11.69	7.10	<0.001 (HS)
51-60 (24)	34.81	9.23	15.83	9.35	<0.001 (HS)
Total	30.68	10.36	13.06	8.41	<0.001 (HS)



Results:

Following the intervention, there was a statistically significant reduction in pad weight (mean from 31.26g to 7.52g, $p < 0.001$) and PVR volume (mean from 278.67 mL to 116.63 mL, $p < 0.001$). Improvements were consistent across all age and occupational subgroups, with the greatest impact seen in housewives aged 51–60.

1. **Age-wise Distribution of Cases:**
   - The age distribution of patients in Group I and Group II shows that the highest proportion of cases in both groups falls within the 51-60 years age range (Group I: 40%, Group II: 40%). The age group 31-40 years had 30% of total cases, and 41-50 years accounted for 30%. The chi-square test revealed no significant difference in age distribution between the two groups (Chi = 1.78, $p = 0.41$, NS).
2. **Mean Age of Patients:**
   - The mean age of patients in Group I was 46.10 years (SD = 9.39), and in Group II, it was 47.40 years (SD = 8.25). The p-value (>0.05) indicates no significant difference in the mean age between the groups.
3. **Occupation-wise Distribution of Cases:**
   - In Group I, the majority of patients were housewives (56.67%), followed by employed individuals (33.33%). In Group II, the majority were housewives (76.67%), with employed individuals making up 16.67%. The chi-square test yielded no significant difference in occupation distribution (Chi = 4.90, $p = 0.17$, NS).
4. **Pre and Post PVR in Group I by Occupation:**
   - The pre and post-void residual (PVR) values showed a significant reduction in all occupation categories ($p < 0.01$ for employed, $p < 0.001$ for housewives, $p < 0.05$ for retired), with the total PVR decrease being highly significant ($p < 0.001$). The greatest decrease was observed in housewives, with a reduction from 292.18 mL to 202.50 mL.
5. **Pre and Post PVR in Group II by Occupation:**
   - Group II also showed significant reductions in PVR across all occupations, with housewives showing the most significant reduction ($p < 0.001$), from 293.65 mL to 115.52 mL. The total PVR decrease in Group II was also highly significant ($p < 0.001$).
6. **Total Pre and Post PVR Distribution by Occupation:**
   - Across both groups, significant reductions in PVR were observed in all occupations ($p < 0.001$). Housewives showed the highest decrease in PVR, from 293.03 mL to 151.21 mL.
7. **Pre and Post PVR by Age Group:**
   - In Group I, the PVR decreased significantly across all age groups ($p < 0.01$ for 31-40 years, $p < 0.001$ for

41-50 years and 51-60 years). Similarly, in Group II, significant reductions in PVR were noted across all age groups ($p < 0.001$ for all). The total PVR decrease was highly significant in both groups ($p < 0.001$).

8. **Pre and Post Pad Weight by Age Group:**
   - Both Group I and Group II showed significant reductions in pad weight across all age groups ($p < 0.001$), indicating improved outcomes after intervention. In Group I, the total pre-pad weight was 30.10 g, which decreased to 18.60 g ($p < 0.001$). In Group II, the total pre-pad weight was 31.26 g, which decreased to 7.52 g ($p < 0.001$).
9. **Pre and Post Pad Weight in Group I by Occupation:**
   - Significant reductions in pad weight were observed in all occupations in Group I ($p < 0.05$ for employed and retired, $p < 0.001$ for housewives). Housewives showed the greatest decrease in pad weight, from 32.59 g to 21.03 g.
10. **Pre and Post Pad Weight in Group II by Occupation:**
    - Significant reductions in pad weight were also observed in Group II ($p < 0.01$ for employed, $p < 0.001$ for housewives). Housewives in Group II showed the most significant reduction in pad weight, from 33.62 g to 7.24 g.
11. **Total Pre and Post Pad Weight by Occupation:**
    - Significant reductions in pad weight were observed in all occupations across both groups ($p < 0.001$). Housewives demonstrated the greatest decrease in pad weight, from 33.18 g to 13.10 g
    - groups ($p < 0.001$), particularly in housewives.

We used the pad test but because of the different geography and climates it affects drying and soaking capacity, we added ultrasonography to objectifying the technique and better results. Additionally, it was seen that the bladder's overall capacity increased after the session in population which is enrolled for the studies, that has been indicated the bladder contractability and its urine holding capacity also been remarkably improved (the primary goal of the ultrasonography is to improve future results by marking the role of bladder muscle contractibility, which is not considered in previous studies).

5. DISCUSSION

Urinary incontinence (UI) is a prevalent condition characterized by the involuntary leakage of urine, with various subtypes, including stress, urge, mixed, overflow, and functional incontinence. Stress urinary incontinence (SUI) often results from weakened pelvic floor muscles, commonly seen in women post-childbirth or during physical exertion. Urge urinary incontinence (UUI) is associated with detrusor overactivity, leading to a sudden, intense need to urinate. Mixed incontinence combines features of both SUI and UUI, while overflow incontinence occurs due to bladder outlet obstruction or impaired detrusor contractility, often linked to neurological conditions or benign prostatic hyperplasia in men. Functional incontinence arises from environmental or physical barriers that hinder timely access to a toilet.[ii]

Pelvic floor dysfunction (PFD) plays a significant role in the development of UI, encompassing a range of symptoms and anatomical changes due to muscle weakness, hypertonicity, or improper coordination. The pelvic floor's anatomy, primarily composed of the levator ani group (puborectalis, pubococcygeus, iliococcygeus), provides structural support and facilitates urinary and fecal continence. Dysfunctional pelvic floor muscles can lead to conditions like pelvic organ prolapse (POP), characterized by the descent of pelvic organs into the vaginal canal, causing discomfort and urinary issues.[iii]

Research highlights the efficacy of pelvic floor muscle exercises (PFME) in managing SUI and mixed incontinence. Supervised PFME programs show better outcomes compared to unsupervised ones, with cure rates ranging from 16% to 27% and improvement rates from 48% to 80.7%. Age does not significantly impact the effectiveness of PFME, suggesting its applicability across different age groups.[iv]

Furthermore, emerging studies explore the intricate connections between the jaw and pelvis through fascial lines and craniosacral biomechanics. These connections suggest that emotional stress and physical tension in the jaw can influence pelvic floor tension or visa versa, potentially contributing to UI and PFD. This highlights the importance of holistic approaches in managing UI, considering both physical and emotional health.

Overall, understanding the complex interplay between pelvic floor anatomy, neurological control, and emotional factors is crucial for effective prevention and management of urinary incontinence.

In the previous studies or protocol for pelvic floor rehabilitation is not addressing the real time lacunas and not also been considering the psychosomatic involvement along with secondary physiological dysfunction which is causing a loop and also the traditional exercises for pelvic floor are tough to achieve the optimum result outcomes. The exercises which have been in practice is ironically suggesting the problem which is suffering by sufferer like suggesting holding in between stream during micturition it is ill practical because already he/she is suffering with urinary incontinence.

Same as the exercises which is having too many of instructions followed by steps. The first issue is communication barrier of the terminology along with the idea of area which is explained by therapist because language barrier, literacy and variance in rural & urban population, secondly the exercises required assistance and supervision is required which is again practically not possible for proper rehabilitation outcomes.

In conclusive, the practical method of exercise is also not in a functional position that is necessary to fill the real-time application result for the same, which makes it inconclusive. It is as if we are teaching separate subjects and expecting explanations of different subjects. Overall, understanding the complex interplay between pelvic floor anatomy, neurological control, and emotional factors is crucial for effective prevention and management of urinary incontinence.

6. CONCLUSION

This study clarifies the embryological connection between jaw and pelvis (through neural tube) along with the role of breathing is clearly showing significant changes in **GROUP 2.** Thus, one of the many benefits of K-CAT is its simplicity. It is functional and requires no equipment and assistance. Integration of techniques which focuses on the body as a whole simultaneously putting emphasis on the anatomical, physiological, psychometric, nutritional and emotional aspects will always be a better approach. Embryological connections can be used as a guide to navigate in future studies. As **jaw & pelvis** relaxation pose with breathing along with exercises are proven to be effective in managing **Urinary Incontinence** significantly with lesser effort and a greater reduction is seen in time taken to achieve the same goal with conventional physiotherapy exercises. Future studies required with bigger population group to identified more deeper connections and evident the protocol for betterment of society, which will help in managing the condition more precisely and efficiently.

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