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Review Article

Appraising Current Literature on Centric Relation in Relation to Developing Prosthodontic Occlusion

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Abstract: Centric relation plays significant role in establishing dental occlusion in artificial prosthesis, while at the same time it cannot be violated by any restorative procedures. Across various times of dental prosthodontic evolution, the centric relation has been defined in different contexts with an attempt to make it more clinically understandable. In the past few decades, with the evolution of digital dentistry, there has also been significant developments in computer related graphics and simulation which has led to better understanding of difficult scientific interpretations. This article in the form of a review has been aimed to appraise the current literature related to centric relation in terms of its definitions, methods and clinical complications. The review also attempts to review most common method of recording centric relation.

Keywords: Centric Occlusion, Jaw Relations, Complete Denture, Implant Dental, Jaw Relations.

INTRODUCTION

Complete denture prosthesis treatment therapy relies on precise maxillo-mandibular relations, including centric and eccentric relations [1]. These include protrusive, right and left lateral maxillomandibular relations, and all other intermediate positions, establishing antero-posterior and medio-lateral dynamic jaw connections, in this case through artificial teeth [2]. The importance of centric relation in complete denture prosthodontics is widely recognized, with many authors stating it is the most crucial single clinical measurement that is individual to each patient. However, agreement on its definition and recording remains unresolved due to many factors and evidences that negate many hypothetically defined concepts.[1] Recording horizontal jaw relation involves obtaining a base or reference line for simulating various mandibular movements in an articulator, which serves as a initial point for developing occlusion or occlusal contacts on dentulous and edentulous casts [3]. This basic reference line position corresponds to the transverse hinge axis and is known as the centric relation position. This complex term includes condylar, mandibular, static, passive, and dynamic power positions [1-3]. The term centric relation originates from the concept of "center" or "center-oriented relation" in the jaw relationship. Condylar centricity, first proposed by Gysi [4], is considered a "zenith of the fossa" relation. The term "centric relation" is difficult to dispense or substitute, as it refers to the central position for mandibular movements. This biological relation between the two jaws is primarily significant for all types of occlusal rehabilitations including conventional fixed partial dentures or any of its treatment designs (spring, fixed movable or cantilever) [5, 6], or that for modern day implant supported removable or fixed partial dentures [7]. The definition of centric relation has evolved over time, with the current definition proposed by the Academy of Prosthodontics as a maxillo-mandibular relationship with an anterior superior position of the condyle disc complex on the slopes of articular eminence. This relationship has not significantly changed the objective or procedure of recording centric relation. There are several types of centric relation, including the most retruded physiologic relation, the most posterior unstrained position, the most posterior relation of the lower to the upper jaw, the midmost, uppermost position, the uppermost and rearmost position, and the anterior uppermost position [8-10]. These relationships can exist at various degrees of jaw separation and can be determined clinically without pain or derangement in the TMJ. Most definitions are topographical, describing the condyles' location in centric relation or the mandible's position.

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They don't explain the importance of centric relation and its consequences if incorrectly recorded in prosthesis, causing denture instability and impaired masticatory performance [1-7].

Evidence against Discrepancies in Centric Relation Definitions

The glenoid fossa, a thin, translucent roof in dry specimens, lacks articular cartilage but contains minute foramina for blood vessel and nerve passage, and is occupied by the thickened posterior zone of articular disc [11]. The condylar head's superior portion is designed for stress, with articular cartilage covering it. The functional health of the temporomandibular joint components are influenced directly by the functional occlusion especially the clearances (overjet, overbite, posterior disclusion) [12]. The posterior eminentia's bone trabecular struts are parallel to forces, indicating the distal slopes are designed to withstand stress [11]. The articular disc, located between the condyle and posterior eminence, is a stress-bearing area with a non-stress-bearing periphery rich in blood vessels and nerves, with the thickest posteriorly and thinnest middle part [13, 14], the temporomandibular joint health is also affected by the psychological health of the individual and occlusal habits that are present in him [15]. The posterior eminentia articulating with the articular disc's intermediate zone and anterior face of the condylar head is the most logical arrangement for centric positioning of condyles [3-13].

Features & Significance of Centric Relation

Centric relation is a clinically crucial position in the construction of complete dentures, fixed partial dentures, implant supported all prosthetic options and all types of occlusal rehabilitations starting from a single posterior tooth to full mouth rehabilitations, as it is the ideal bone-to-bone relationship and functional position of jaws for TMJ and musculature health [3-12]. It is a learned position that can be voluntarily and reflexively returned to, and is independent of teeth presence or absence [2-16]. It is a reproducible, recordable, consistent reference position and a physiologically acceptable position for deglutition [2-16]. It is a hinge position, allowing for pure rotation without translation, and serves as a starting point for articular adjustments [1-3]. In dentulous subjects, improper recording of centric relation can endanger periodontal structures and prevent occlusal reconstruction [5]. The centric relation is a complex term with condylar and mandibular dimensions [2]. It consists of condylar centric and mandibular centric positions [16]. Proponents of the retruded concept believe both positions are retruded, while anterior-superior concepts argue the condylar position is superior-anterior. The dispute lies in the mandible's condylar position. Static centric relations in articulators are static positions of upper and lower casts at a predetermined occlusal height, while dynamic centric relations involve condyle-disc assembly to temporal bone during mastication and deglutition. Gerber designed a condylar articulator to accommodate the resiliency of the temporal joint (TMJ) by addressing condylar compression and distraction [17]. Centric relations in the temporomandibular joint are interpreted based on loading [16]. They can be passive centric, seen during jaw closure, or power centric, observed during mastication and deglutition. The joint faces high compressive forces, more than 2.7 times that of the occlusal table [11-13]. During mastication and deglutition, loading progresses, with condyles seated against the avascular aneural zone of the disc [14]. Joint behavior under compression loading is classified as light, medium, and heavy, with centric defined as passive and power centric. Centric relation is the terminal position in mastication, but it does not directly contribute to mastication [2]. Mastication occurs when the mandible reaches the centric position within the hinge opening range, not at the static centric jaw relation position [1]. Teeth should not contact during mastication, and a portion of food bolus is always present between the upper and lower cusps of teeth [3-9]. Centric relation is acquired mainly during swallowing and is considered the most retruded idle position.

Significance and Inter-Relationship between Central Relation and Central Occlusion

Occlusion refers to the contact between opposing teeth, including centric occlusion, intercuspal occlusion position (ICP), retruded contact position (RCP), terminal occlusion, and centric occlusion in a centric relation, where teeth are in a centric occlusion and jaw is in a centric relation [3-9]. Centric occlusion and centric relation are tooth-to-tooth and bone-to-bone positions, respectively [16]. In natural teeth, both exist, but centric relation remains for artificial dentures. Dentulous individuals may have centric occlusion, but it doesn't necessarily mean centric occlusion [12]. When centric occlusion doesn't coincide, condyles can take a position. When the occlusion and condylar centric locations interfere, occlusal reconstruction can fix it [9]. The goal of occlusion rehabilitation is to establish a stable central occlusion, often called "organic occlusion." [3-12]. Centric relation and centric occlusion hardly seldom occur simultaneously in humans during normal occlusion [17]. Two ideas have evolved from the idea of centric occlusion contacts: the first is point centric, also known as gnathological centric occlusion, which happens when centric occlusion and centric relation coincide; and the second is long centric, which lets patients transition between centric relation and centric occlusion without changing the occlusion's vertical dimension [18, 19]. Both natural and restored teeth rely on this centric mobility to avoid damage and preserve alveolar bone structure. Long centric occlusion is based on the findings that mastication occurs near centric occlusion and seldom in centric relation, while deglutition is near centric relation. This concept is essential for occlusal rehabilitation and enables harmonious mastication and deglutition within the centric field. The normal physiological function of both is essential for proper occlusal functions and every prosthetic design irrespective of being complete or partial, removable or fixed, implant supported or tooth supported should take these occlusal determinants into consideration [20-22].

Muscle Function and Centric Occlusion

The centric relation is a bone-to-bone connection controlled by muscles, including the ligaments and articulating disc [19]. It can be restored without a pathologic condition. Muscles are divided into positioner and elevator muscles [11]. Positioner muscles pull the mandible forward and back, while elevator muscles elevate the condyles and hind the jaw. In normal resting position, depressor and elevator muscles contract and release simultaneously to open the jaw. Williamson studied muscle contraction in a centric relation, finding that the superior head of the external pterygoid braces the disc against the articular eminence, while the temporalis positions the condyle superiorly [23]. The masseter and medial pterygoid contract during centric power closure, suggesting an anterior-superior positioning of the condyle against the eminentia [14]. No muscle is attached to the condyle to pull it vertically or retrude the mandible. Before obtaining a centric relation, factors such as the operator's ability to manipulate the mandible, the patient's cooperation, and the resiliency of soft tissues over edentulous areas must be considered.[24] Boucher suggests two concepts: minimal closing pressure to prevent tissue displacement during recording, and heavy closing pressure to ensure even displacement of soft tissue during recording [25]. This will prevent the patient from clenching and relax the closing muscle during periods of mastication. Equality in distribution may cause soreness and changes in residual ridges [5-20]. To retrude the mandible, patients should relax their jaw, pull it back, and close slowly on their back teeth. They should feel the pressure of pushing their upper jaw out and closing their back teeth together. Repeating protrusion and retruding while holding fingers against the chin is highly recommended [26]. Turning the tongue backwards towards the posterior palate, tapping the occlusion rims or back teeth together, tilting the head back, and then palpating the temporal and masseter muscles to ensure muscular tension in centric. The recording material should be consistent, not offering resistance during mandibular closure, and have sufficient strength and rigidity to support the models during the mounting process [27-29]. Functional methods of recording centric relations have disadvantages such as unstable bases, inaccuracy due to displaceable basal seat tissues, resistance, and lack of equalized pressure control, and moreover patient's good neuromuscular control is required [23]. The intraoral tracing device is strong and can be held in place with a locking device, making it ideal for patients with habitual centric dentures. Gothic arch tracing eliminates occlusal contact from occlusal rims, eliminating the likelihood of sliding the lower jaw forward [30]. However, it has disadvantages such as difficulty in visualizing the tracing, difficulty in finding the true apex, and the need for a tracer seated in a hole for accurate plaster injection [19-30]. Gerber identified six types of gothic arch tracings: classical pointed form, classical flat form, weak tracing, asymmetrical form, miniature form, and tracing with vertical line beyond arrow point.[31,32] These types are observed in dentulous and edentulous conditions. Typical gothic arch tracings have a well-defined apex with symmetrical left and right lateral components, indicating a healthy TMJ without interferences in condylar path and balanced muscle guidance [30]. Flat form tracings have more obtuse left and right lateral tracings, indicating marked lateral movement of condyle in the fossa [30]. Asymmetrical form tracings have a non-symmetrical inclination to the protrusive path, indicating inhibition of forward movement. Apex absent/round form tracings show weak retrusive movement. Miniature tracings have limited extension due to restricted mandibular movements, improper seating of record bases, and painful fitting during registration [32]. Double arrow points are records of habitual and retruded centric relation [31]. Dorsally extended arrow points indicate forced strained retrusive movement of the lower jaw [30]. Interrupted gothic arch breaks or loses continuity of lateral incisal path.[32] Atypical form tracings may occur in dentulous patients due to faulty muscular patterns or edentulous patients using complete dentures with incorrect centric relation. The graphic method is preferred for good edentulous ridges with normal interarch relations, but is not suitable for resorbed or flabby ridges [33]. It's not recommended for inadequate interarch distance, cannot be traced in TMJ arthropathy patients, and can't be used with large awkward tongue or pendulous tissues. It's also challenging to locate the center of arches in unfavorable relation.

Inaccurate Centric Relation Recording Complications

The TMJ structure can cause instability, soreness, and resorption due to deflective occlusal contacts [14]. If jaws operate as hinges, maxillomandibular relations are automatically registered, but condyles can be easily malpositioned [13]. Tissue resiliency, also known as "Realeff," is present in both mucosa and TMJ, making centric registration complicated [34]. Ensuring the relation under pressure avoids excessive displacement of soft tissue. Mechanical complications include lost exact centric relation due to human inaccuracy and changes in denture base materials due to inherent shrinkage in heat cure acrylic resin material [21]. Psychological difficulties arise when a patient or dentist experiences uncertainty or tense due to the importance of recording [35]. Incorrect centric relation recording can lead to periodontal damage, hypersensitivity, tooth mobility, masticatory muscle pain, headaches, neck and shoulder pain, premature contact, TMJ dysfunction, and mucosal irritation and soreness [14]. It also affects denture retention and stability, causing potential complications.

Conclusion

Recording horizontal jaw relation in prosthetic procedures is crucial for relating mandibular movements in an articulator. A centric relation is a ligamentous position, and three main requirements are to record the horizontal relation of the mandible to the maxilla, apply equal vertical pressure, and keep the completed record in a condition that won't distort until casts are mounted. Different methods and materials have been employed to register accurate centric relation positions. Bilateral manipulation and swallowing methods provide clinically acceptable results, but they don't locate the mandible in the same position as the graphic method. Functional methods have disadvantages, such as requiring stable record bases and patient neuromuscular coordination. The best method for recording centric relation should be individual patient and clinician's skill-oriented approach.

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