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Real Time Tscan Pattern of Occlusion Monitoring and Correction For Dentistry

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ABSTRACT: T-Scan has become more popular to record the pattern of occlusion and has many advantages as being simple to operate, dynamic viewing, timed analysis of force during various positions of teeth and therefore the possibility of permanent documentation for monitoring the occlusal condition after carrying on the assorted treatment protocols. Adaptive Correlations Analysis(ACA)algorithm are self- designing filters allows the filter to “learn” the initial input statistics and track them for time varying. These filters estimate the deterministic signal and takeaway the noise correlated with the deterministic signal so on identify Positions and distance from an another Neighbor Node.

AODV (adhoc on demand distance vector), a loop free routing protocol for adhoc networks. at each node to maintains a routing table. self-starting in an environment of mobile nodes withstanding a range of network behaviors like node mobility, link failures and packet losses.

DSR (Dynamic source routing), on-demand protocol will not restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required within the table-driven approach. The Efficiency is high in AODV compared to DSR.

KEYWORDS: Occlusion, Bite force, AODV, DSR, TScan sensor, NS-2.

I.INTRODUCTION

Communication system plays a vital role in data transfer from Wireless Sensor Networks (WSNs). security and Considerable flexibility to the user is an integral part of any communication technique. In hospital environments, TScan sensor applications include the seamless interoperability of wireless medical devices and WSNs in a common communication platform for medical environmental surveillance applied in dentistry.
Occlusion is a common topic of discussion in many fields of dentistry: Orthodontics, Prosthodontics, Implant Dentistry, Oral &Maxillofacial Surgery, Periodontics & Pedodontics. TScan has become more popular to record the pattern of occlusion. accurately and dynamically records the time, force &area of occlusal contacts, views on the reliability of the T-Scan system as a method for occlusal contact registration has always been questioned, especially regarding its repeatability for accuracy.
Millstein et al. [5] and Reza Moini et al. [6]), reminds the occlusal factors acting on the teeth are examined by articulation paper marks, waxes, pressure indicator paste, etc. are the tools available to assess the forces of the occlusion and also to evaluate the occlusal contacts. However, the disadvantages of these methods are that they do not detect simultaneous contact nor do they quantify time and force. There is no scientific correlation between the depth of the colour of the mark, its surface area, amount of force or the contact timing sequence that results as the articulation paper marks.

Harvey. [7], Arcan and Osborne on the combination of dental articulating paper and patient feel. Commonly used quantitative occlusal approaches include a computer aided video system, a photo occlusion method and the T– Scan system.

Hsu M, Gallo [8], Bio Research Associates, Inc and Tekscan Inc corporations, developed a commercially available system (T-Scan) that overcomes the known limitations of articulation paper marks It quantifies and displays relative

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occlusal force information, so that the clinician can minimize repeated errors of incorrect occlusal contact selection. There are many upcoming computers based treatment modalities, but many clinicians have not overcome the traditional methods for examining the occlusion. This study was conducted to evaluate the distribution of occlusal loading forces and correction of any occlusal discrepancies using TScan.

Mizui et al.[9], measured the timing and force of occlusal contacts in normal subjects and patients with an unspecified craniomandibular disorder (CMD) using T-scan system and found that in normal subjects the timing and force of occlusal contacts were symmetrical and the centre of effort was located in the first molar region.

Hirano et al.[11], vitro study on accuracy and repeatability of the T-Scan II system conducted by reported that T-Scan force recordings were acceptably precise, especially for the moderately high level and default level.

Koos et al.[12], reported that the level of accuracy is acceptable and no interferences arouse from change in foil or repeated measuring was detected with T-Scan III. The author didn't find any inaccuracy as mentioned in the past, which may be due to an upgrade in T-Scan III.

O' Brien WJ et al.[23], Balancing ramps may promote denture balance through the smooth sliding between the prosthesis. Besides the excellent esthetics due to the anterior overjet, it is possible to have more stability during the food bolus interposition than in the classical balanced bilateral occlusion pattern.

Profitt et al.[27], An individual's occlusal status is generally described by two major characteristics: a) intra-arch relationship i.e. the relationship of the teeth within each arch to a smoothly curving line of occlusion and b) inter-arch relationship i.e. the pattern of which occlusal contacts between the upper and lower teeth.

Richard et al.[25],Premature occlusal contacts are frequently detected in subjects with chronic periodontitis and are significantly correlated with its severity. The posterior teeth with high occlusal forces in patients with untreated chronic periodontitis may reflect occlusal trauma associated periodontal conditions, that could probably increase the risk of further periodontal break down.

Kerstein et al.[33], It quantifies and displays relative occlusal force information, so that the clinician can minimize repeated errors of incorrect occlusal contact selection. There are numerous upcoming computer based treatment modalities, but many clinicians have not overcome the traditional methods for examining the occlusion. This study was conducted to evaluate the distribution of occlusal loading forces and correction of any occlusal discrepancies using Tekscan.

II. TSCAN SENSOR IN DENTISTRY

TScan Sensor is the complete digital occlusal analysis sensor helps clinicians to detect premature contacts, high forces, and interrelationship of occlusal surfaces. the important data cannot be captured by traditional, analog occlusal methods, like articulating paper.

The T-Scan Sensor is used to produce the high resolution and repeatable accuracy and

• Wafer-thin, with the flexibility to resist 15-25 closures

• High resolution Sensels for precise data

• Reusable

• Cold sterilize between visits

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T-scan system:

Tekscan Inc29 introduced the Windows-compatible, digitized occlusal analysis T-scan system, method for registering inter-arch occlusal contacts dynamically during various mandibular movements and for representing these in a graphic form in real time, giving information about their duration for their duration according to its relative force. The system was designed to facilitate diagnosis of occlusal dys function, to guide practitioners in delivering occlusal equilibration of natural and prosthetic teeth, especially of implant-supported prostheses.

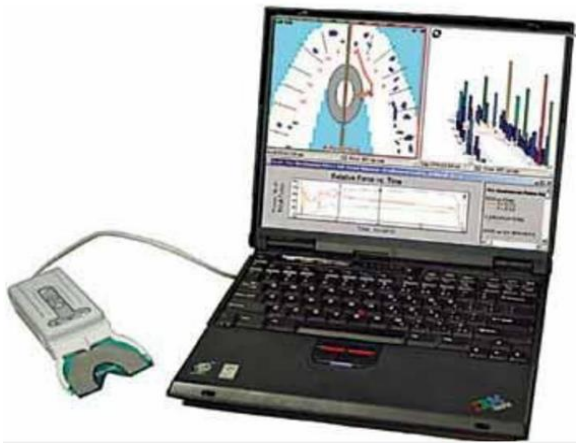

Fig.1.Showing computer system attached to sensor handle

T-Scan is a computerised occlusal force analysis device comprising of three parts.

- **a.** A sensor and support
- **b.** Handle assembly
- **c.** system unit,computer software and a printer

.The patient bites of a thin (75 micron) sensor, made up of columns and rows of pressure sensitive ink, trapped in a Mylar sandwich.The sensor is attached to a handle that scans at thousandth of a second time intervals. The handle reads the data from the sensor to pass it to the computer that presents the data to understand visual display.

Fig. 2. T-scan system. Fig. 3. Flexible Sensor

The Tscan system consists of a disposable sensor, an autoclavable occlusal adaptor, connected to an electronic sleeve to the USB port of a laptop b: the sensor is 85mm thick and versatile sensor, Fig.2, slim horseshoe-shaped sensors, used

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repeatedly for a one patient are made from 1370 active pressure sensing locations (1122 pressure sensing locations for smaller sensors), Fig. 3. Eighty-five microns thick it encloses a double layer of Mylar, a special ink. A force applied to every of those cells modifies the electric conductivity of the Mylar.
The program records and analyses the differentials of applied voltage gives relative values of the force and duration of occlusal contacts, with a time precision of 10 ms. The results are delivered in the form of graphs describing force variation with time; force histograms are projected on an individualized dental arch (that can be modified according mesio-distal tooth dimensions or missing teeth) allowing the practionner to picture the location and duration of inter-arch contacts over time. Before bite registration, one must calibrate the sensitivity of the T-scan to accommodate the patient's muscular force such that the system can detect very light contacts without becoming saturated by heavier contacts.

Tscan Sensor and its Layers

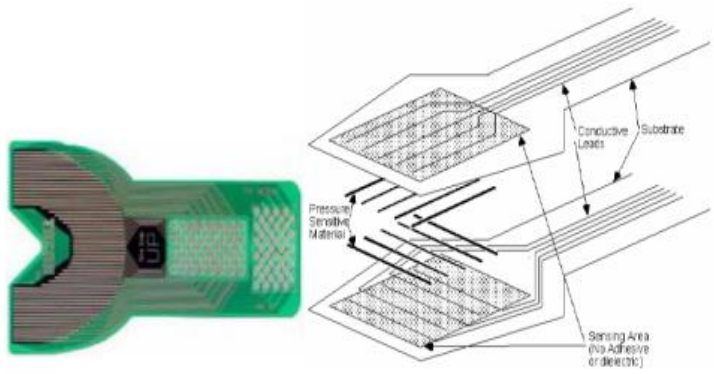

Fig. 4. Sensor and its layers

Recording technique - The recording handle with the sensor and arch support is placed between the maxillary central incisors of the patient, Fig.5. The recording is initiated by pressing the button on the recording handle. The patient is asked to close the mouth till complete intercuspation is reached, without making any excursive movements.

Fig. 5. Showing patient recording

Applications of Tscan

Application of T-scan is seen in: Fixed & Removable Prosthetics, Implant Prosthetics, TMD Appliances, Occlusal Equilibration, Disclusion Time Reduction, Abfraction Management, Periodontal Management, Differential Diagnosis, Orthodontics, Locating Painful Teethand Dental Case Finishing.

Case finishing: From single unit fillings to full mouth recuperation it's important for patient comfort, restoration life to get a balanced occlusion with collective anterior/posterior protection. As articulating paper does not measure force, balance or timing, it is not a sophisticated enough media to calculate on. T-Scan allows a clinician to case finish with accuracy and confidence.

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Diagnostic Screening: Occlusal trauma is the cause of a large number of pathologies in the mouth. Abfraction, bone loss, exostosis, periodontal pocketing, as well as cusp breakages, restoration failure and excessive wear. Measuring the force and timing of a functional bite is essential for accurate diagnosis.

Implantology: As implants do not flex in the periodontal socket. Controlling the force on restored implant prosthesis is difficult enough without working "blind" by not measuring it at all. The T-Scan shows in thousands of a alternate time intervals how force is applied to neighboring teeth and implants.

Cosmetic Dentistry: Case finishing for cosmetic dentistry can be the difference between and successful case and a failure. Due to the precise nature of cosmetically driven cases, being having confidence that the restorations will be functional and veneers will not de-bond, is a tremendous asset.

III. PROTOCOLS AND NS2

AODV (Ad-hoc On-demand Distance Vector): a loop-free routing protocol for ad-hoc networks. It's designed to be self-starting in an environment of mobile nodes, withstanding a range of network behaviours like node mobility, link failures and packet losses. At each node, AODV maintains a routing table. The routing table entry for a destination contains three essential fields: a next hop node, a sequence number and a hop count. All packets destined to the destination are sent to the subsequent hop node. The hop count represents the current distance to the destination node.

In AODV, nodes discover routes in request-response cycles. A node requests a route to a destination by broadcasting an *RREQ* message to any or all its neighbours. When a node receives an RREQ message but does not have a route to the requested destination, it successively broadcasts the RREQ message. Also, it remembers a reverse-route to the requesting node which can be used to forward subsequent responses to the present RREQ. This process repeats until the RREQ reaches a node that contains a valid route to the destination. This node (which can be the destination itself) responds with an *RREP* message. This RREP is unicast along the reverse-routes of the intermediate nodes until it reaches the first requesting node. Thus, at the end of this request-response cycle a bidirectional route is established between the requesting node and the destination. When a node loses connectivity to its next hop, the node invalidates its route by sending an *RERR* to all nodes that potentially received its *RREP*.

Advantages of AODV:
Reliable for the wireless mesh networks.
Loop free and does not require any cartelized system to handle routing process for wireless mesh networks.

Disadvantages:
Shortest path may be lost due to traffic during the path discovery process. A large number of control packets generated in link failure. Consumes network bandwidth. Level of QoS decreases with an increasing network density.

DSR (Dynamic Source Routing): a routing protocol for wireless mess networks. It is similar to aodv in that it forms a route on-demand when a transmitting node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device. This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply).

To return the Route Reply, the destination node must have a route to the source node. If the route is in the Destination Node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the Route Request message header (this requires that all links are symmetric).

Advantages of DSR:
Generally independent of the network size. Routes are maintained only between nodes that need to communicate. This reduces the overhead of route maintenance.
A single route discovery may yield many routes to the destination, due to intermediate nodes replying from local caches.

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Disadvantages

Less secure due to the broadcast and multicast routing updates. Additional configuration settings such as passive interfaces and routing protocol authentication are required to increase security. Packet header size grows with route length due to source routing. Potential collisions between route requests propagated by neighboring nodes.

NETWORK SIMULATOR(NS2)

Network simulator is a tool which is needed for the simulation purpose. The simulation of the practical results needs to be a veritably important part for exploiting in world script. Simulation is the process of designing a model of a real system and conducting trials with this model for the purpose of understanding the geste of the system and assessing colorful strategies for the operation of the system. With the dynamic nature of computer networks, we therefore actually deal with a dynamic model of a real dynamic system. Simulation is that the reproduction of some real thing and state of affairs or process. The act of bluffing commodity generally entails representing certain crucial characteristics or behaviours of a named physical or abstract system. Simulation is used in numerous surrounds, similar as simulation of technology for performance optimization, safety engineering, testing, training, education, and videotape games. Training simulators include flight simulators for training aircraft aviators. Simulation is also used for scientific modelling of natural systems or mortal systems in order to gain sapience into their functioning. Simulation can be used to show the eventual really goods of indispensable conditions and courses of action. Simulation cannot be used as the real system terrain. Network simulator (also popularly called NS- 2) is an open source separate event network simulator. Since its commencement in 1989, NS2 has continuously gained tremendous interest from assiduity, academia, and government NS is used in the simulation of routing protocols, among others and is heavily used in ad- hoc networking exploration. NS2 supports popular network protocols, offering simulation results for wired and wireless networks likewise. It's popular in exploration given its open source model and online attestation. To probe network performance, experimenters can simply use an easy- to- use scripting language to configure a network and observe results generated. NS2 has come the most extensively used open source network simulator and one of the most extensively used network simulator.

IV. REAL TIME CORRECTION OF OCCLUSION USING TSCAN ANALYSIS

CASE 1: Tscan Records at an interval initially of Base line after 3 months and before 6 months

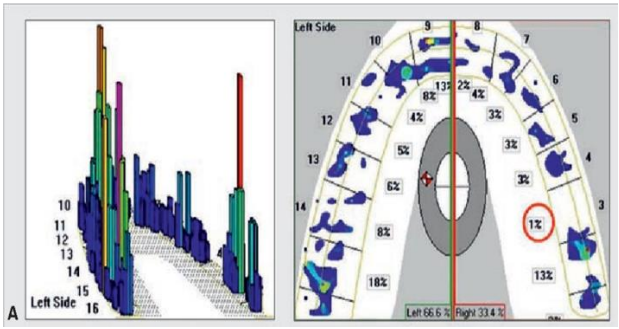

Figure 6: T-Scan occlusal analysis of a patient at three different intervals. Note that tooth no. 3 (maxillary right first molar) was replaced by an implant-supported crown. Prosthetic placement appointment (baseline measurement)

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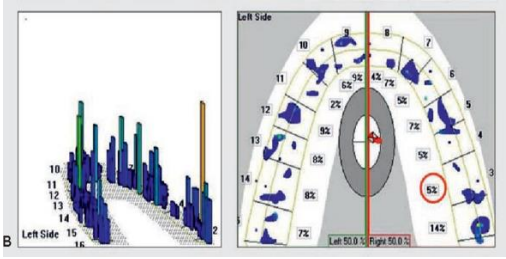

Figure 7: At three-month follow-up

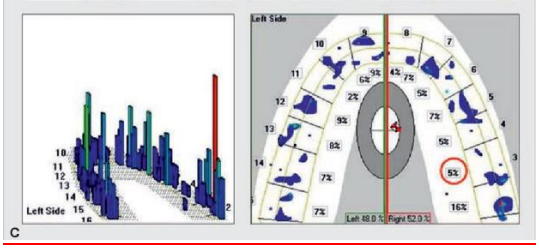

Figure 8: At six-month follow-up

CASE 2:

Tscan records of 3 and 6 months' retention period Intraoral views of a Class II division 2 malocclusion treated by a combined surgical-orthodontic protocol with a customized lingual appliance technique

In this case the patient experiencing ''occlusal discomfort'' after the removal of orthodontic appliances and treated with a combined surgical and orthodontic non-extraction approach for a Class II division 2 malocclusion, Fig. 9a–9c and 10a–10c made various T-scan first on the day lingual attachments were removed and then at 3 and 6 months into the retention period, Fig.11a–11c.

a: Before treatment. The extruded position of the mandibular anterior teeth seems to be the principle component of the anterior overbite.
b: Pre-surgical situation showing clear bonded buttons in place on both arches.
c: Post-treatment. Note the slight canines's infra-occlusion. Immediately after appliance removal, bonded an anterior lingual retention wire and proceeded to the first registration; as no contacts in the anterior region of the arch is observed such that occlusal forces were exerted primarily on the molar teeth, weakly on the bicuspids, and most forcibly

Figure: 9a to 9c Clinical case 1:

on the right side. The upper and lower right second molars supported 41% of the total force discerned by the sensor. This initial distribution signified a slight anterior open bite that we interpret as resultant from the differential in thickness between the upper lingual attachments and that of the bonded retention wire that replaced them. Accordingly, the marks made by articulating paper on the canines were false positives.

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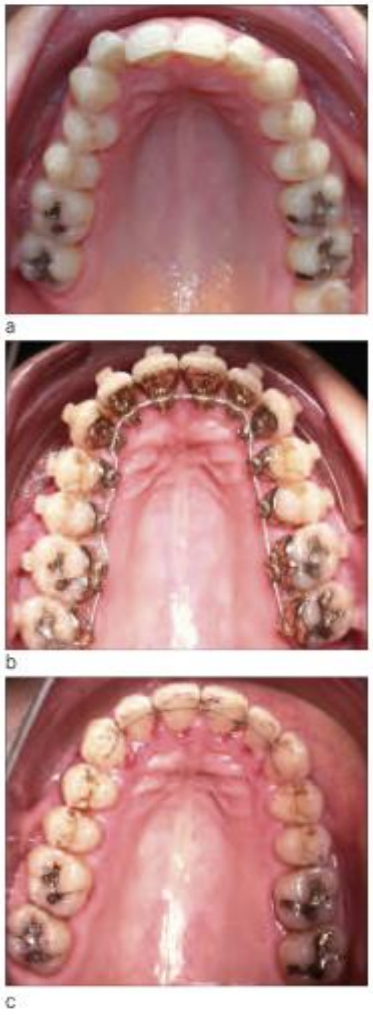

Occlusal views of the maxillary arch.
a: Before treatment.
b: Pre-surgical. Note the bite planes incorporated in the canine lingual attachments to help leveling of the mandibular arch.
c: Appearance on the day of appliance removal, with a lingual retention arch wire bonded between the maxillary canine, and the occlusal marks made by Bausch two-sided articulating paper.
Note the clear marks on the molars and the weaker marks on the left second bicuspid and the right cuspid. The incisal marks appear to be false positives caused by folding over of the articulating paper

At the 3-month check-up visit, the patient described a feeling of uneven contact between the upper and lower molar teeth on the right and left sides that was not apparent from articulating paper markings (as shown in the intraoral view of the maxillary arch. Even though post orthodontic physiological eruption (‘‘settling’’) brought the upper and lower anterior teeth into contact, the force of their occlusion remained weak, as the right side occlusion took 66% of the total contact forces, demonstrating its dominance. The center of force depicted by a diamond has clearly shifted to the right.

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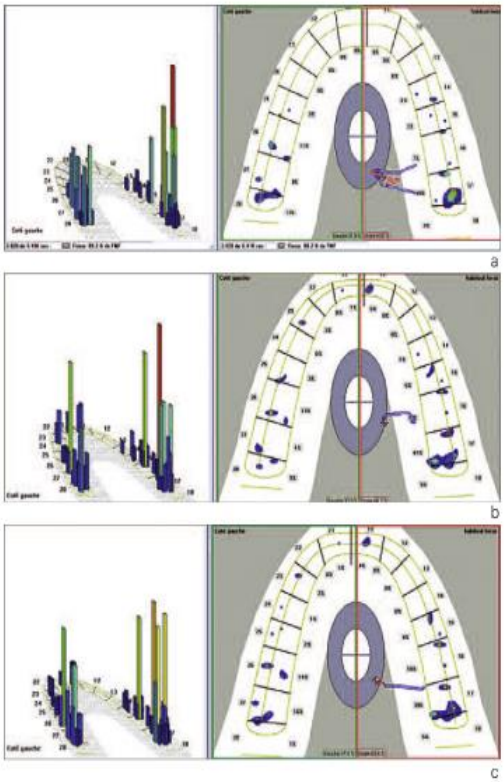

T-scan III registration, occlusal view.
a: On the day of appliance removal only posterior teeth, primarily the molars, are in contact with their antagonists. Contact between upper and lower bicuspids is weaker. The red diamond shows clearly that the center of force has drifted to the right, and shows oscillations.
b: Three-month recall visit. Note that the upper and lower anterior teeth have begun to come into contact because of physiological extrusion. The center of forces is still located on the right but with fewer oscillations. The contact between the upper and lower second molars is still strong.
c: Six-month recall visit. The patient's sense of occlusal discomfort was eradicated by equilibrating the amalgam filling on the occlusal surface of the maxillary right second molar. The occlusal forces are more balanced but still somewhat heavier on the right. The upper right lateral incisor and canine teeth are still out of contact with their lower antagonists.

Figure:11a to 11c Clinical case 1:

At 6 months relieved high spots on the amalgam filling in the upper right second molar to reduce the force sustained by this single tooth and to encourage a better distribution of occlusal forces. noted the histogram tracings of forces exactly followed the shape of the occlusal portion of the amalgam restoration, Fig.10c. However, the asymmetry of interarch contacts persisted and their distribution throughout the maxillary arch remained unchanged. Because of the absence of clinical signs and the eradication of occlusal discomfort, no further equilibration is undertaken despite the residual asymmetry in the occlusal forces. encouraged the patient to continue the physiotherapy prescribed after maxillofacial surgery and asked to balance mastication between the right and left sides to eliminate functional asymmetry.

Comparison of articulating paper markings and T Scan recordings to evaluate occlusal force in normal and rehabilitated maxillofacial trauma patients

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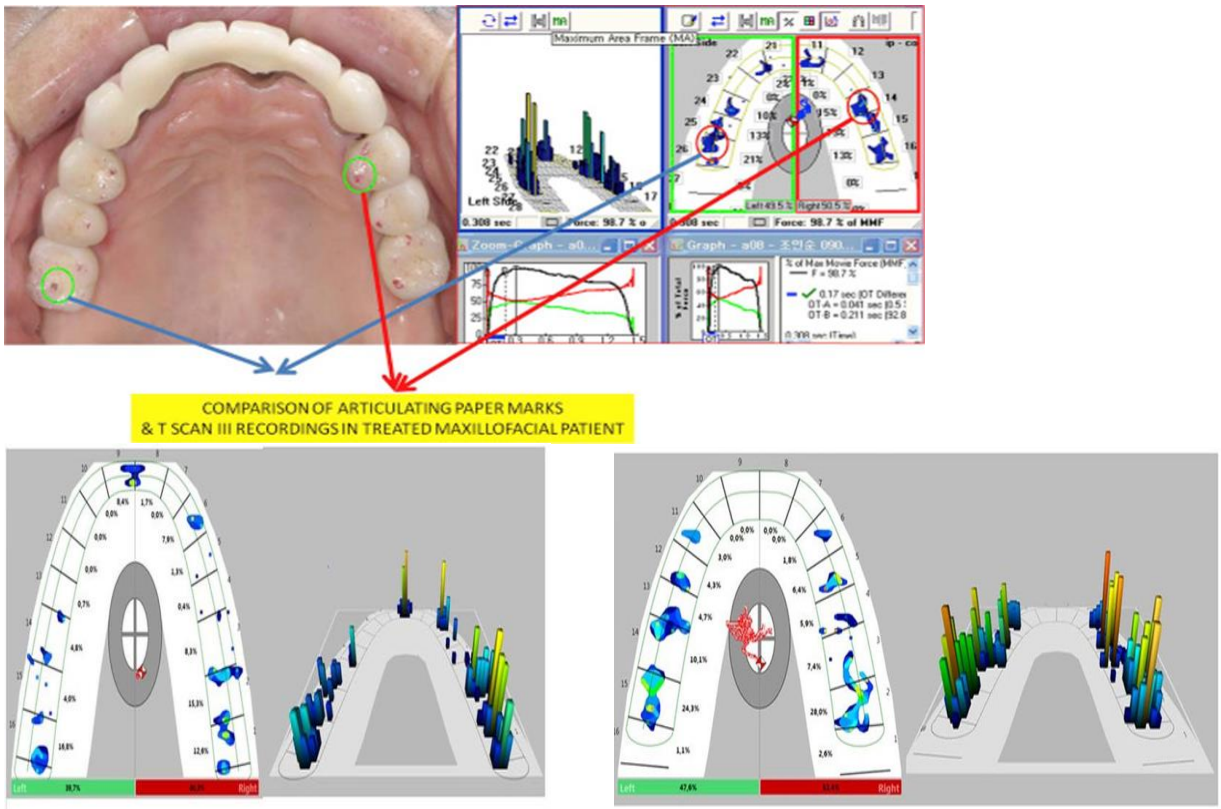

Figure 12: Occlusal force distribution before and after surgery using T-Scan

V. SIMULATIONS AND RESULTS

Communication protocol AODV and DSR used for transmission and receiving files. i.e., TScan1.tcl and TScan2.tcl
In TScan1.tcl Tscan image will be generated as a packet automatically the Tscan image is converted to packet. In TScan2.tcl is an improvement enhancement file means record image will have generated. Neighbor nodes are interacting with Base station. Neighbor Node 12 starts selecting Neighbor node 13 and checking strength by sending connection request Neighbor node 13 does not send response for connection request yet... Neighbor node failed to send response for connection request**.** Neighbor node 12 marks 13 as Low energy node, Supplementary node 2 starts establishing the path between Neighbor node 13, Node 12 starts Transmission with Neighbor node 13.

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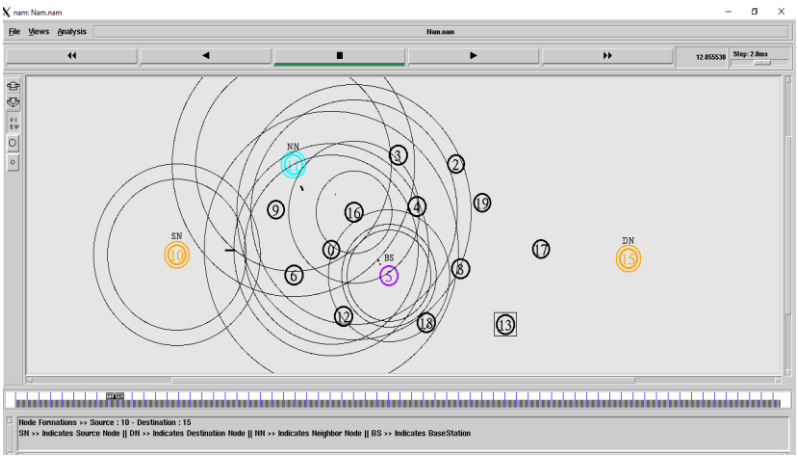

Figure13: Neighbor nodes are interacting with Base station

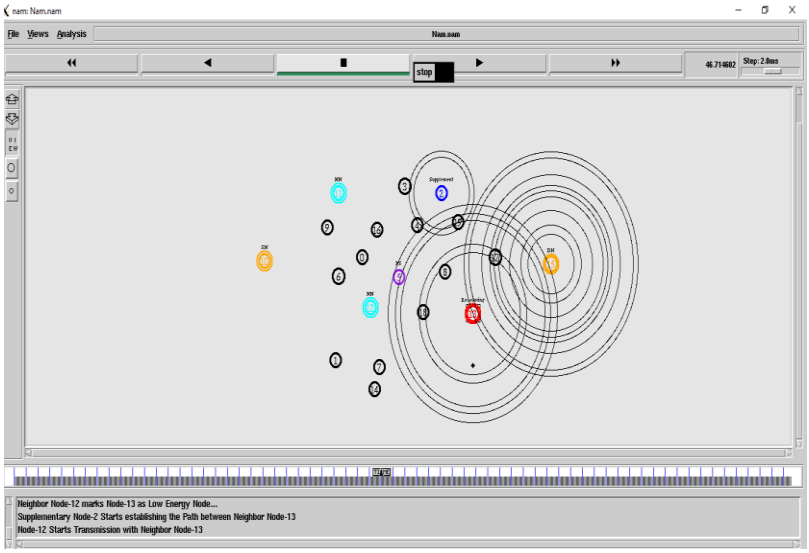

Figure 14: Neighbor node 12 marks 13 as Low energy node, Supplementary node 2 starts establishing the path between Neighbor node 13, Node 12 starts Transmission with Neighbor node 13

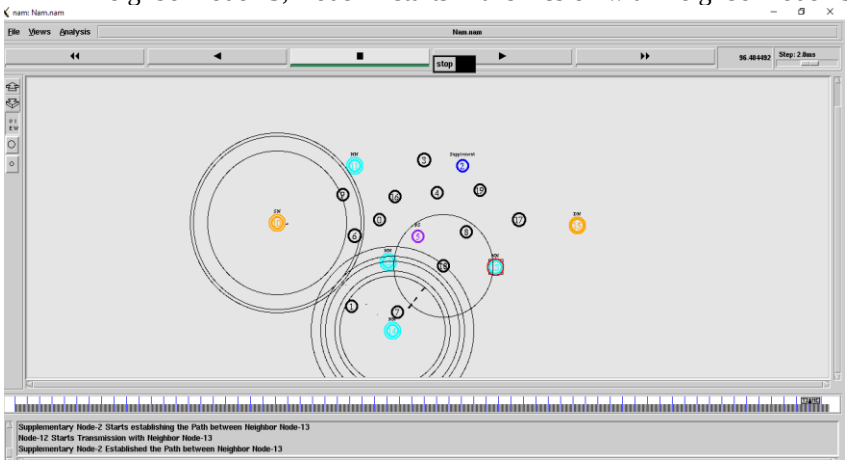

Figure.15: Neighbor node12 starts transmission with Neighbor node13, supplement node 2 starts established the path between Neighbor node 13

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Tx-0 node starts communication with Destination node-22 Via Active Neighbor Nodes, Tx-0 starts communication with Active Neighbor node 91 and we can see packets dropped. Active Neighbor Node 91 starts Communicating with other Active Node 6 then starts communication with another Active Neighbor Node 28, Fig. 17.

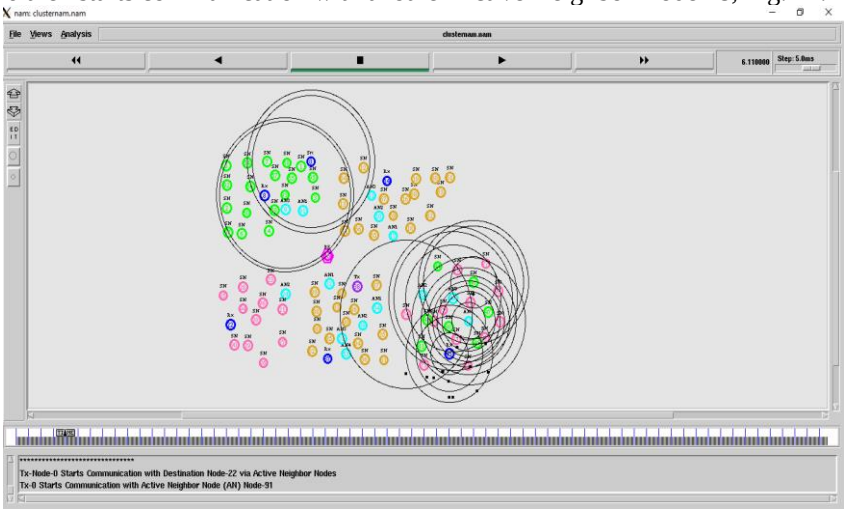

Figure 16: Tx-0 node starts communication with Destination node-22 Via Active Neighbor Nodes, Tx-0 starts communication with Active Neighbor node Node91 and we can see packets dropped.

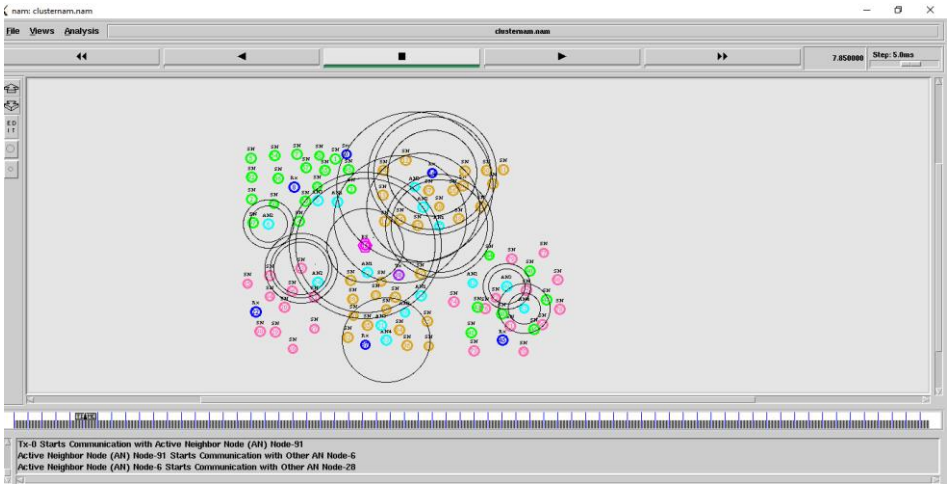

Figure 17: Active Neighbor Node -6 starts communication with other Active Neighbor Node -2

Graph shows the energy consumption, network delay and Throughput of AODV and DSR with respect to Nodes based on the parameters such has packet size, transmission range, packet rate, packet Transpeed frequency and average delay graph will be generated. In Comparison Graph Energy consumption improved, Lifetime improved, Delay decreased, Throughput increased.

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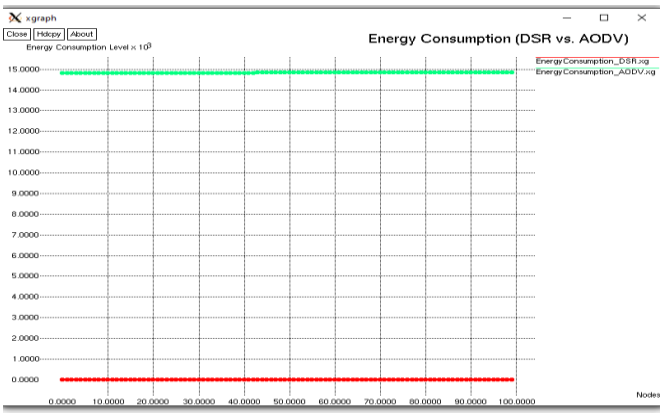

Figure 18: Comparison graph of Energy Consumption of DSR and AODV

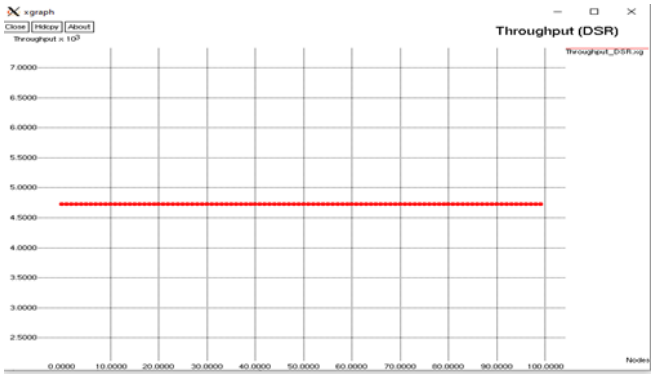

Figure 19: Throughput of DSR protocol

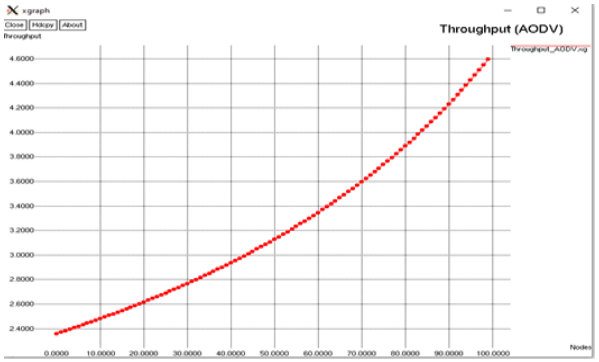

Figure 20: Throughput of AODV protocol

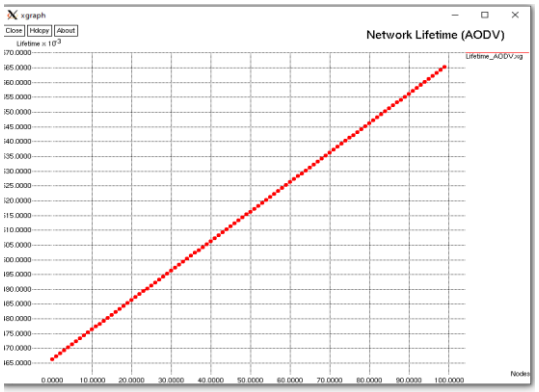

Figure 21: Network Lifetime of AODV protocol

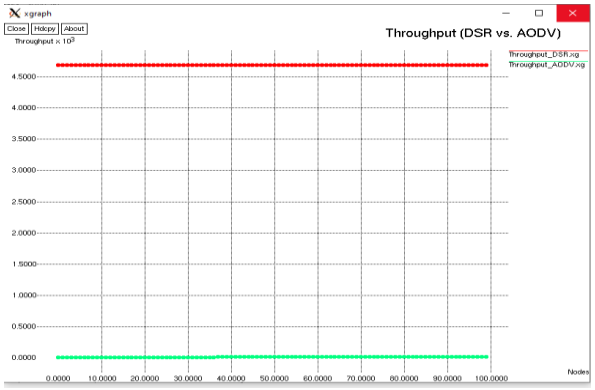

Figure 22: Comparison graph of Throughput of DSR and AODV

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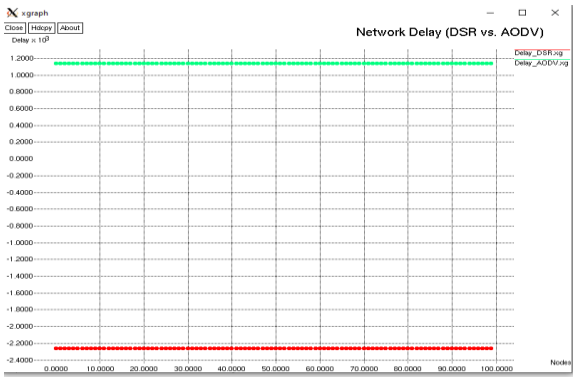

Figure 23: Comparison graph of Network delay of DSR and AODV

VI. CONCLUSION

The T-scan system is a new computerized occlusal analysis tool that can provide an abundance of information, that might even exceed our present day clinical requirements. Beyond the controversy over the effectiveness of occlusal equilibration as a treatment modality for abfraction lesions, periodontal defects, or bone loss around implants, the T-scan system offers orthodontists immediate access to patient's functional occlusion. They can see the static and dynamic quality of inter-arch contacts in real time in a form that can be preserved in a record for comparison at any future date. The T-scan precision, which can be quantified in milliseconds and square millimeters, has won recognition as a reliable T-Scan has become more popular to record pattern of occlusion though it precisely, dynamically and area of occlusion contact but there is a occlusional contact registration has always been especially regarding its repeatability and accuracy.

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